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THE SHELL OIL PIPE LINE

BY H. W. CROZIER.

THE DENVER WATER CONTROVERSY

BY GEORGE M. BULL.

BUILDING GOOD WILL FOR THE POWER COMPANY

BY E. B. CRIDDLE

CHART FOR GRAPHIC DETERMINATION OF FLOW OF WATER IN PIPES BY HAZEN & WILLIAMS FORMULA

PREPARED BY GEO. J. HENRY.

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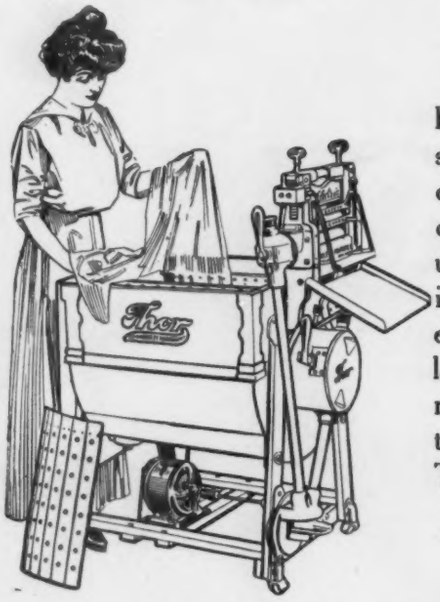

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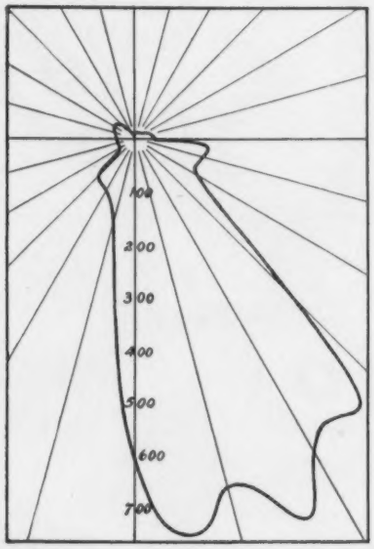

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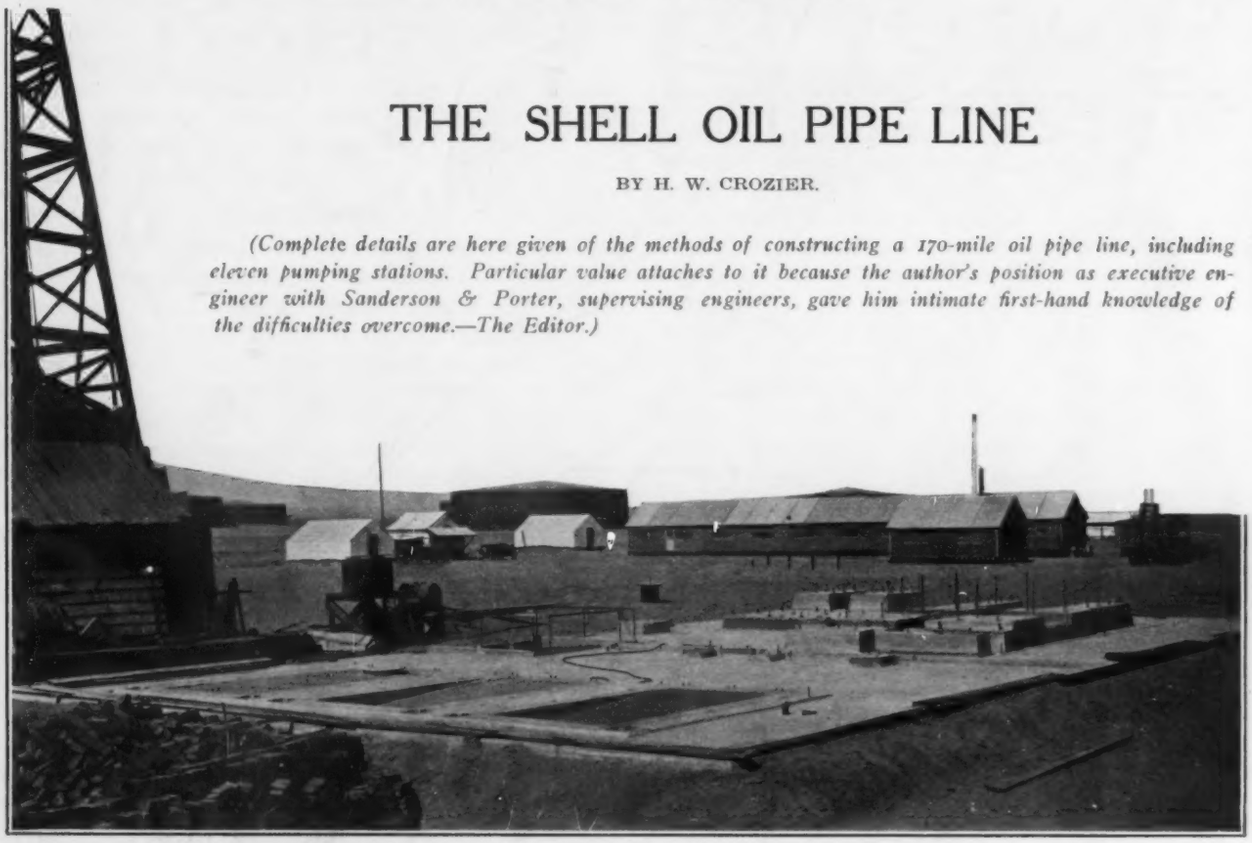
THE SHELL OIL PIPE LINE

BY H. W. CROZIER.

(Complete details are here given of the methods of constructing a 170-mile oil pipe line, including eleven pumping stations. Particular value attaches to it because the author's position as executive engineer with Sanderson & Porter, supervising engineers, gave him intimate first-hand knowledge of the difficulties overcome.—The Editor.)



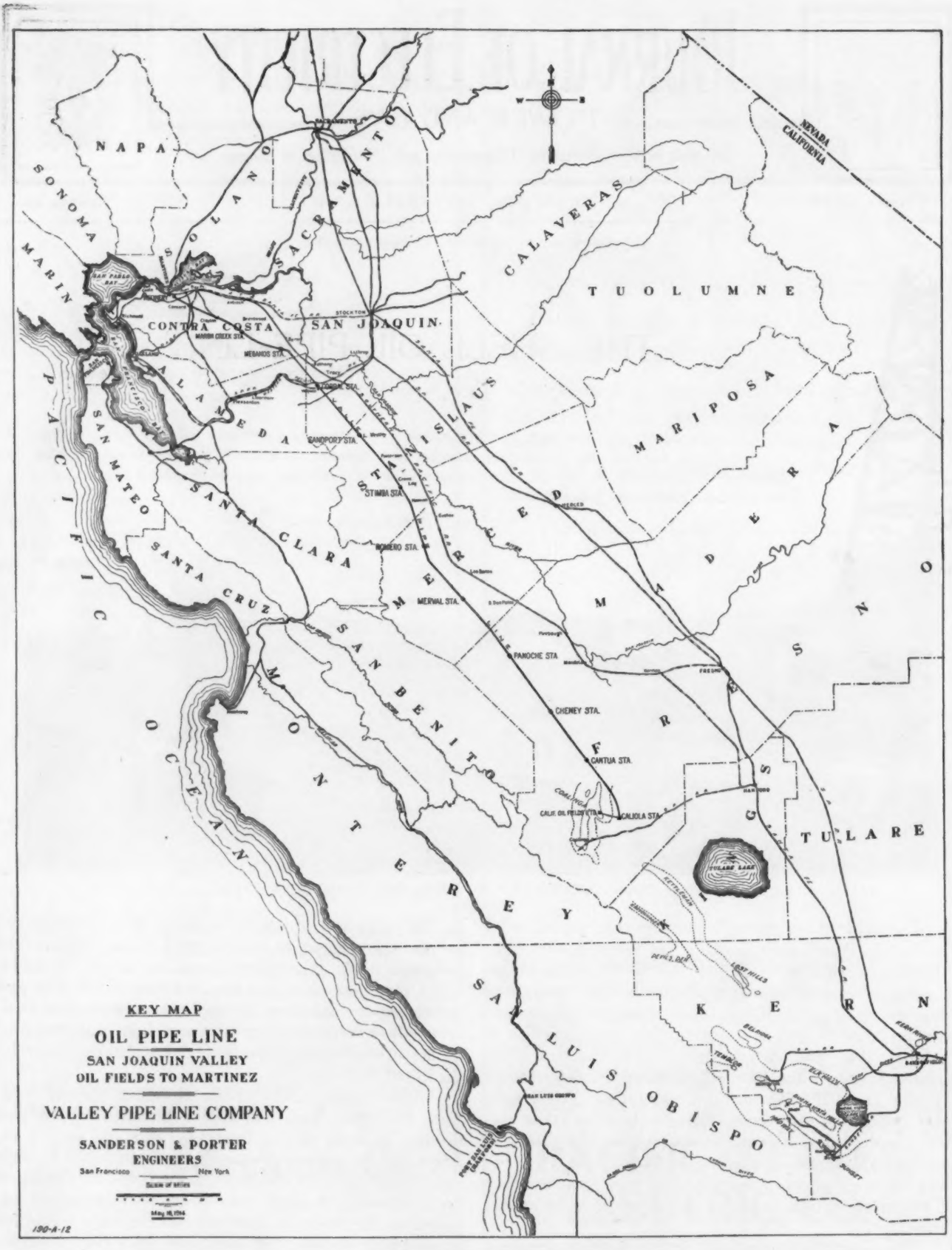
Pioneer Camp of Valley Line at Calola Station and Tank Farm.

Delivery of oil through the 170 mile pipe line of the Valley Pipe Line Company ten months after construction work commenced is worthy of comment as a notable accomplishment. Surveys and the commencement of right of way acquirement were authorized on May 21, 1914. Construction work started in October, 1914, and oil was delivered to the new Martinez refinery of the Shell Company of California on August 11, 1915. Materials aggregating 30,000 tons were purchased after competitive bids were taken under complete detailed specifications, and the total expenditure involved approximated $4,000,000. It is believed a description of the pipe line and some account of the construction methods employed may be of interest.

The pipe line commences at the recently acquired properties of the Shell Company of California in the Coalinga oil fields, known as the California Oilfields, Ltd. This property has been producing oil for a number of years and selling it to the various refining and marketing companies which have pipe lines in the Coalinga field. At various times the project of building a pipe line to tide water, erecting a refinery and delivering the products directly to consumers has been seriously considered, but was not finally determined on until after the property had been taken over by the Shell interests.

After careful study of the merits of lines to Ventura, Port San Luis and San Francisco Bay, it was decided to build to San Francisco Bay and erect a refinery on its shores, because its fine harbor, giving deep water for tank steamers, made it the best location for a refinery. A large tract of land was acquired adjacent to the town of Martinez, where deep water for ocean-going vessels was available, and the construction of a refinery and pipe line authorized.

Sanderson & Porter had examined and reviewed the various alternate routes which were under con-



Map of Valley Pipe Line.

sideration for pipe lines between the oilfields and the sea, and when the Coalinga-Martinez line was selected were instructed to proceed with its construction.

Reconnoissance.

In January, 1914, a reconnoissance was made to select a route for the pipe line between the Coalinga oilfields and the refinery site at Martinez. During this reconnoissance the weather was stormy and heavy rains fell, so that, while the reconnoissance was made under great difficulties, the results obtained were of the highest importance, as it was possible to view the country, the streams and all conditions in their worst aspect. A report on the feasibility of the pipe line, accompanied by numerous photographs, was prepared and submitted. After consideration had been given this report, Sanderson & Porter were instructed on May 21, 1914, to proceed with the acquirement of rights of way and other preliminaries looking to the construction of the pipe line.

Final Surveys.

Location surveys were immediately started and three alternate lines run from the oilfields to Martinez. The adopted line closely skirts the eastern edge of the foothills of the Coast Range from the oilfields northward until the vicinity of Mt. Diablo is reached, where it ascends the valley of Marsh Creek to a low pass, summit elevation 955 ft.; and descending crosses the Walnut Creek Valley to Martinez. This final line is considerably shorter than the alternate surveyed lines, which followed the railroad on the west side of the San Joaquin Valley parallel to the pipe lines of the Standard Oil Company and Associated Pipe Line Company, and, it is believed, is from six to eight miles shorter than any of the existing pipe lines between Coalinga and San Francisco Bay. It was not so far from the railroad as to involve any serious extra expense due to hauling and its location on the higher and dryer land was such that the cooling of the oil in the pipe in the winter would be a minimum as compared with the lines in the lower lying and, in winter, water-soaked lands adjacent to the railroad.

General Design.

The method selected for conveying oils in this pipe line is known in California as the "hot oil process," to distinguish it from the "rifled process," wherein oil is pumped through a rifled pipe with an injected film of water between the oil and the pipe. In the hot process the oil is heated to increase its fluidity. This method has been found best for handling California crude oils, particularly those of 16 degrees Baume gravity and lighter, and especially for handling refining oils such as those produced by the California Oilfields, Ltd.

In California pipe lines equipped to handle the general run of oils, it has been found by experience that pumping stations for main 8 in. trunk lines can be located about 13½ miles apart. On this line the pumping stations are located 15 miles apart, this being accomplished by constructing each pumping division with about two-thirds 8 in. pipe and one-third 10 in. pipe. The oil is heated at each of the pumping stations. Its viscosity increases rapidly as it cools, the function of the 10 in. pipe being to compensate in a measure for the increase in viscosity of the oil. By this means considerable saving in first cost of the pipe line was made, because of the omission of two pumping stations costing about $300,000, with an excess of about $50,000 for 10 in. pipe instead of 8 in. pipe, making a total net saving due to this tapering pipe scheme of approximately $250,000.

The method of calculation used in determining the proper relation of 8 in. and 10 in. pipe is interesting, but will be reserved as the subject of a future article.

There are eleven pumping stations, each designed to handle 25,000 bbl. of oil per day at a pressure of 800 lb. per sq. in., which is about the maximum safe pressure for which pumps and pipe have been developed.

In each station there are two oil heaters using exhaust steam from the main pumping engine. A back pressure of about 2 lb. per sq. in. is maintained when pumping the heaviest grade oils, which are then heated to from 110 degrees to 140 degrees Fahr. The lighter oils are only heated to a moderate degree, or not at all, depending on their gravity and viscosity. As the exhaust steam of engines is used in the heaters the engines are necessarily operated non-condensing, although much of the water is condensed in the heaters and returned to the boilers. As nearly all the heat in the exhaust steam is used to heat the oil and the hot condensed water is returned to the boilers, the thermal efficiency of the pumping stations is high.

The pumping stations are located as follows:

Pumping Stations.	Nearest Railroad Station.	Tankage	
Caliola	Turk		
Cantua	Turk	2-37,500	bbl.
Cheney	Mendota	2-37,500	"
Panoche	Firebaugh	2-37,500	"
Merval	Los Banos	2-37,500	"
Romero	Volta	2-37,500	"
Stimba	Crow's Landing	2-37,500	"
Sandport	Westley	2-37,500	"
Corral	Tracy	2-37,500	"
Meganos	Byron	2-37,500	"
Marsh Creek	Brentwood	2-37,500	"
Total		750,000	"
Caliola Tank Farm		1,375,000	
Martinez Refinery Tank Farm		1,100,000	
Total tankage		3,225,000	"

The equipment of the pipe line consists of:

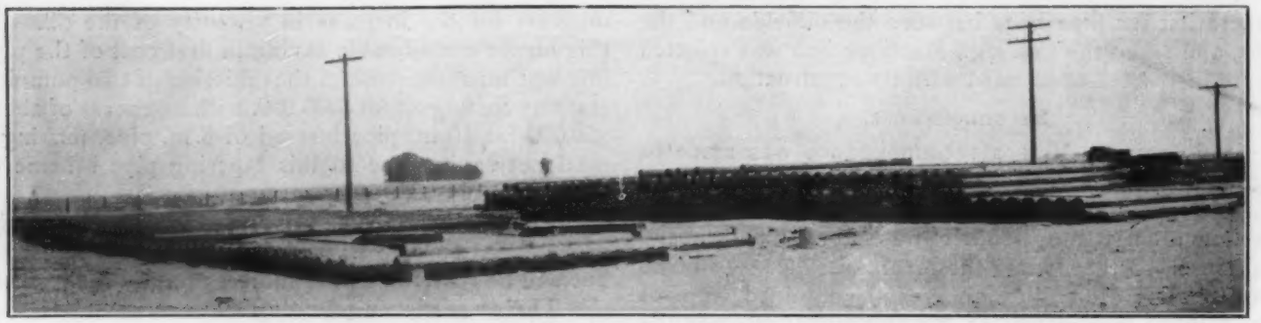
Twenty-two 250 h.p. Heine boilers.
Eleven high duty crank and flywheel type oil pumping engines.
Eleven auxiliary direct acting oil pumping engines.
Twenty 37,500 barrel oil tanks.
Eleven 1200 barrel water tanks.
Eleven steel buildings.

Pipe Line Construction.

The 170 miles of line required approxiately 15,000 tons of pipe, consisting of two-thirds 8 in. and one-third 10 in., furnished by the Youngstown Sheet & Tube Company. The 8 in. pipe weighs 29.2 lb. per ft., and the 10 in. pipe 41.6 lb. per ft. The pipe was specified to come in 19½ foot lengths, but actually averaged from 21 to 22 ft., a very considerable advantage. The couplings were of wrought iron.

The specifications called for Bessemer steel pipe conforming to the following requirements:

Carbon	Not over 0.09 per cent
Phosphorus	Not over 0.105 per cent
Manganese	Not over 0.45 per cent
Sulphur	Not over 0.045 per cent
Tensile strength	50,000 to 62,000 lb.
Elastic limit	Not less than ½ tensile strength
Elongation in 8"	Not less than 20 per cent
Reduction in area	Not less than 50 per cent



Pipe Piles at Railroad Station.

An internal hydraulic test of 1200 lb. per sq. in. for the 8 in. pipe and 1000 lb. per sq. in. for the 10 in. pipe was required, and a special feature of the specifications was the provision that during the application of the pressure test the pipe should be struck with a two pound hammer each 2 ft. of its length, or, as an alternative, a number of pneumatic hammers spaced 2 ft. apart might deliver a volley of blows. All pipe during its manufacture was inspected by Robert W. Hunt & Company.

Upon fabrication, the pipe was delivered by rail to Atlantic coast ports and shipped via Panama Canal to San Francisco, reloaded on cars and shipped to destination. Nearly all of the pipe was trans-shipped from cars to steamers at New York City, although one consignment was trans-shipped at Boston. The pipe came through in excellent shape, not more than one or two joints being injured and there were no losses. Upon arrival the pipe was unloaded to large piles at the railroad stations, and, as required, was hauled to the pipe line site and distributed by teams. After the pipe had been screwed, as described elsewhere, it was filled with water and a hydrostatic test of 900 lb. per sq. in. applied and continued for four hours, during which the line was critically inspected by line-walkers for the detection of leaks. The pressure was applied to each pumping division successively, although at times three or four pumping divisions were under pressure during test, as a matter of convenience.

Trenching Machine at Work.

The tests proved that the pipe furnished and the installation work performed were of high quality and great credit is due the Youngstown Sheet & Tube Company, the manufacturers, and Robert W. Hunt & Company, the inspectors, as well as to the construction forces for excellent workmanship in assembling and placing the pipe.

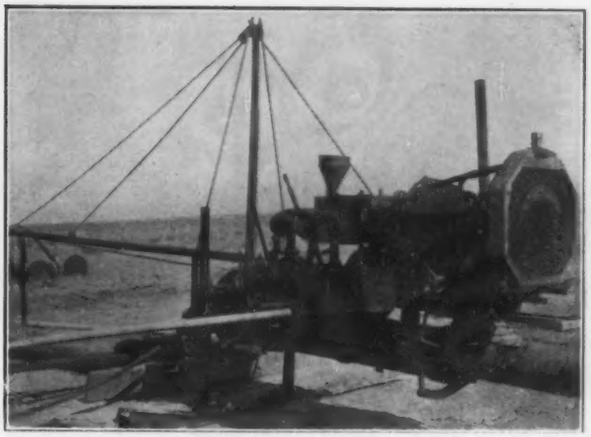
In laying the pipe, the trenching, screwing, application of the protecting covering, and the backfilling work were all done by machinery, except in certain portions of the line where the trenching work and the backfilling work had to be done by hand on account of the precipitous character of the ground. The use of machines made possible very good construction progress and economical operations and also greatly facilitated the commissary and other supply work, as only a moderate force of men was required, probably only one-third of that usually needed in screwing main line-pipe.

Trenching: The trenching work was divided into two portions. One portion of 150 miles was in level or moderately rolling ground, and a contract was let and the work done by traction trenching machines of the large rotating wheel type driven by gasoline engines. The remaining portion of 20 miles was in the rough country in the vicinity of Mt. Diablo and this work was done by hand in the usual manner.

Screwing: A gasoline motor driven screwing machine was used for screwing the whole of the pipe, and, so far as known, this is the first pipe line where all the pipe was screwed by machine, and the second where a machine was used at all, as on a previous pipe line only the more favorable level portions were screwed by machine.

The principal feature of this machine is a steel gear with set of pipe tongs attached, the gear being mounted upon the end of a tubular frame which surrounds the pipe being screwed, and also supports a 4 cylinder 40 h.p. automobile type power plant.

The machine has traction rollers for moving it along the pipe and a pair of gear driven legs or spuds for raising and lowering, as well as tongs for holding firmly to the completed line and the necessary clutches, gears and control levers for its operation. The operator is provided with a seat on the machine within easy reach of the various control levers and on account of the hot climate a canvas awning was also found quite necessary.



Pipe Screwing Machine.

Pipe Screwing Machine Meets an Obstruction.

There were two machines in use, one suitable for screwing 8 in. pipe and the other for screwing 10 in. pipe, and these were used alternately as the work progressed, such maintenance repairs as were required being made on one machine while the other was working. The pipe line was screwed continuously from the initial station northward until Marsh Creek Station was reached, when both machines were set to work and screwed pipe simultaneously. This was done as it was desired to deliver oil to the refinery at the earliest possible date, and a number of experienced men were available, so that by filling out with additional laborers, it was possible to organize two crews of men and within a few days the second crew was brought to nearly the efficiency of the original crew.

In the rough and mountainous country in the vincinity of Mt. Diablo between Meganos pumping station and the refinery at Martinez, a great many bends in the pipe were required and this work was done entirely with the machine except in a few cases where bends of considerable angle occurred necessitating heating of the pipe. The procedure was quite simple. When a bend in the pipe was required the machine was stopped in the middle of the last joint of pipe screwed and the spuds were then extended so as to raise the machine to its highest point. A large pair of pipe tongs were closed on the pipe at the place where the bend was to be made and rested upon a set of blocking tightly wedged. The machine operator then commenced lowering the machine, and, due to its weight, the bend was made, most of the men of the crew standing on the pipe on the other side of the blocking which formed the fulcrum for the bend. By this means an over bend was made. If a side bend or under bend were required the bend was made in the same manner and the pipe turned by the machine afterward. Many bends were also made with a pipe bending outfit operated by a 25 ton Norton jack.

The operation of the machine on straight-away work usually took about 28 men, and it is believed is one of the best examples of efficiency methods that has recently come to notice. The work progressed with great rapidity, a joint of pipe being screwed approximately every minute. Each man had a certain amount of work to do, with an intervening period of rest. The machine operator necessarily was the pacemaker, and the men necessary to handle the heavy pipe and auxiliary pipe supporting horse and perform other services necessary for the operation of the machine had no difficulty in performing their functions as fast as the operator was able to run the machine.

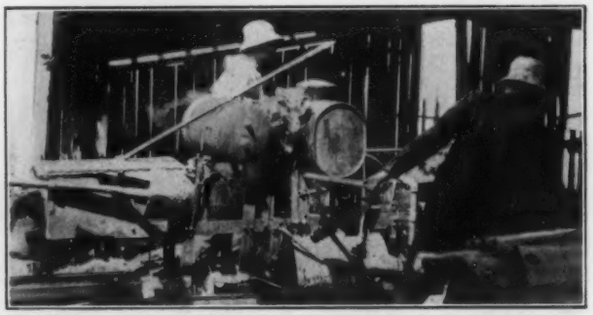
A careful cleaning of the threads and preparing the pipe beforehand was found to be of the highest importance in securing tight work, and this was done in advance of the machine by a few men, who thoroughly and carefully cleaned the threads with petroleum distillate and steel wire brushes, removing all the dirt accumulated in transit and the old protecting grease.

Just before the pipe was placed in the machine the thread on the end of the pipe and that in the collar were painted with Crane cement, furnished by Crane Company of San Francisco. This material was found very satisfactory and its excellent lubricating qualities prevented the collars from heating while the pipe was being screwed.

Experienced pipe line men have usually been opposed to the use of machines in screwing pipe, claiming that the collars would be seriously heated in screwing and that first class tight work could not be done. It is believed that the work done on this line conclusively

Pipe Screwing Machine Near Marsh Creek Station.

Pipe Screwing Machine Has Adventures.



Motor Driven Pipe Cleaning and Priming Machine Following the Pipe Screwing Machine Through a Barn.

proves that pipe can be perfectly screwed by machine if properly supervised and that the work can be done much more economically and promptly than if done by hand.

As an illustration—there were but three collars which required calking between Caliola and Meganos pumping stations, a distance of 141 miles.

The progress on this work, which extended from October 25, 1914, to August 9, 1915, is shown by the following table, operations being approximately continuous except for a period in February and March, 1915, when work was discontinued because the trenching machines were unable to dig trench on account of the saturated condition of the ground.

Month.	Rainfall.	Days Worked.	Pipe Screwed. Feet.	Tons.
October, 1914.....	0.40	5	16,948	260
November, "	0.00	26	102,800	1,680
December, "	5.98	28	114,300	1,972
January, 1915.....	3.74	19	74,900	1,246
February, "	18.75	4	13,454	295
March, "	3.00	13	69,000	1,119
April, "	0.40	26	133,682	2,324
May, "	2.74	23	110,127	1,791
June, "	0.05	30	135,585	2,494
July, "	0.00	31	74,906	1,234
August, "	0.00	9	52,212	957
Total	35.06	214	897,914	15,372

The general average for the whole work covering both sizes of pipe was 4196 ft. per working day. The best day's record of screwing 10 in. pipe was 5700 ft., and on three different days 5600 ft. was screwed. On 8 in. pipe the best day's work was 8700 ft., and 8000 ft. per day were screwed on two other days. The best week's work occurred in the period May 24th to 30th inclusive, when 51,500 ft. of 8 in. pipe were screwed, an average of 7357 ft. per working day. For an extended period covering both sizes of pipe an average of 4374 ft. of pipe was screwed in 43 working days extending from March 18th, when work was resumed after the heavy spring rains.

Protective Covering: The matter of covering for protecting main oil pipe line from the corrosive action of the soils through which it passes was gone into thoroughly and due consideration given to a number of different kinds of protective covering which were offered. The method which has been used to the greatest extent in California consists of wrapping the pipe with either a roofing paper or a saturated roofing felt after a hot application of asphalt has been made and serving the whole with wire to assist in holding the wrapping. Asphalt coating has also been used, as well as crude oil treatment consisting in pouring crude oil into the trench after the pipe is laid and mixing it with sandy material around the pipe.

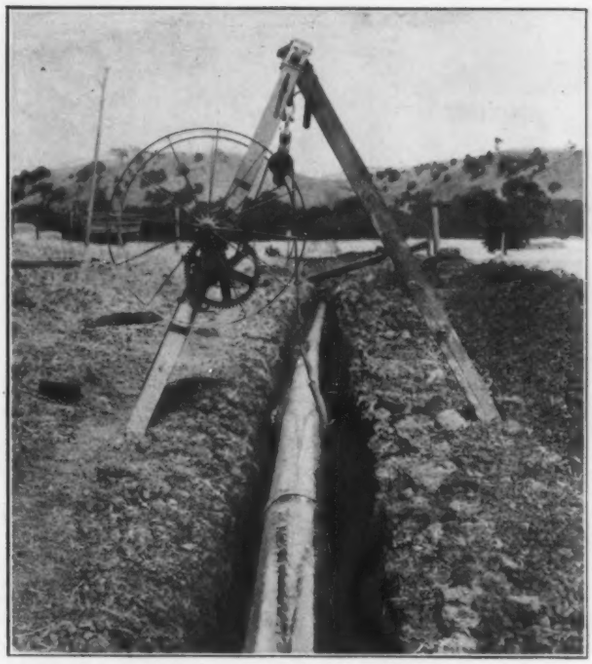
Bitumastic enamel has been applied to about ten miles of the Producers Transportation Company's pipe line near Buttonwillow in the marshy bottom lands near the San Joaquin River with very satisfactory results.

The results of a careful investigation and consideration given the various materials resulted in the decision to use bitumastic enamel, which is manufactured by Wailes, Dove & Company, Newcastle-on-Tyne, England. The excellent condition after five years' service of the ten mile section of the Producers' pipe line, the decision of the United States government to use this material on the Panama Canal gates after considering several hundred competitive materials, its use in the navy and merchant marine, and the further considerable reason that its cost would be no more and probably slightly less than the method so extensively used in California, namely, that of the saturated roofing paper and asphalt, were some of the considerations leading to this decision. The excellent condition and appearance of the finished work lead to the conclusion that this decision was eminently wise.

A contract was entered into with the firm of Hill, Hubbell & Company of San Francisco, who undertook to take charge of the pipe after it was screwed, to apply the bitumastic enamel, lower the pipe in the trench and do the backfilling work.

As this was a job of considerable magnitude the contractor developed machines for the purpose of applying the protecting covering, which consists of two coats, the first a coat of liquid primer and the second a coat of bitumastic enamel, the enamel being solid at

Motor Driven Pipe Cleaning and Priming Machine.



Lowering Machine.

ordinary temperatures. Pictures are shown of the contractor's machines, which are quite ingenious.

The machine for applying the priming coat travels on wheels resting on the pipe and has a rotating brush and scraper on the front end for removing dirt and mill scale, and on the back end a large wheel supporting on moving spindles, the rotating brushes for applying the priming material. This is a most necessary arrangement, as by centrifugal action the priming material is forced to the outer edges of the brushes. The machinery and supporting fly-wheels are driven by a 6 h.p. gas engine. There are three tanks, one for bitumastic solution and the other two for water and fuel for the engine.

Two men are required to operate this machine and in addition three men operate a long lever mounted on wheels with which pipe is raised slightly as required. The pipe when completed by the pipe screwing machine is left on 4x6 wooden skids which rest across the trench, and as the priming machine moves along it is necessary that the pipe be raised and the skids taken around the machine and replaced, and by means of this long lever on wheels the pipe is raised slightly with hose covered chain sling, the skid removed, placed behind the machine, the pipe lowered again and the machine then proceeds.

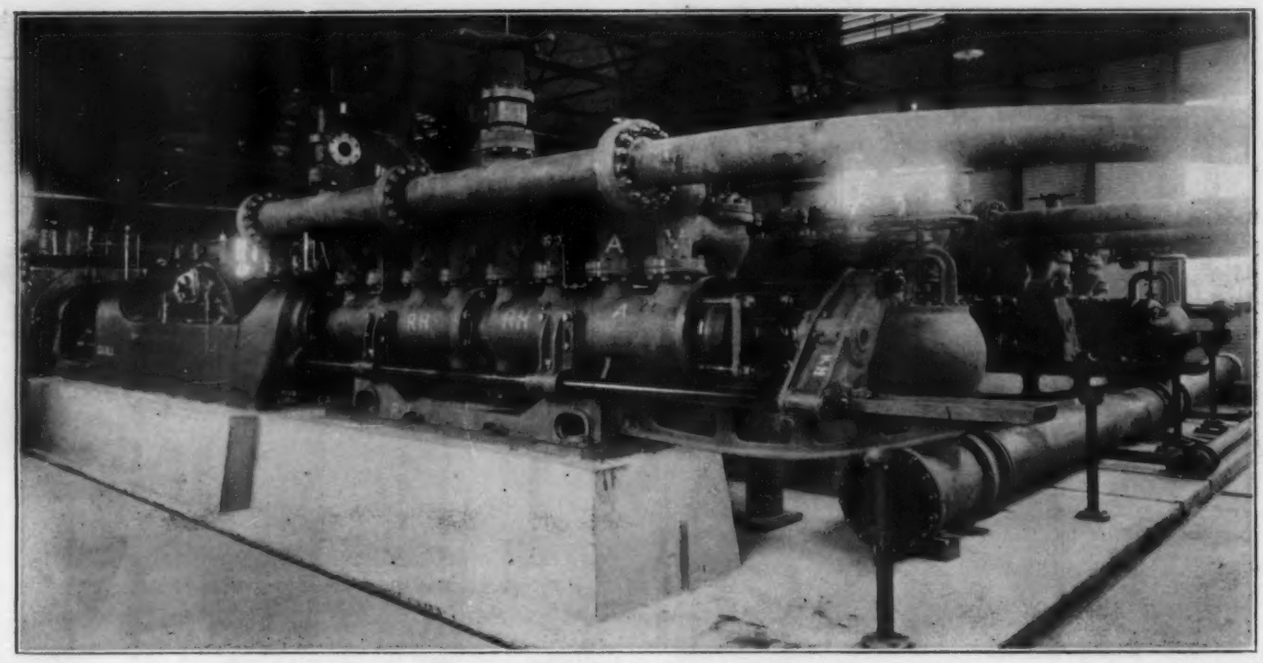
Motor Driven Backfilling Machine.

Effect of Hot Sun on Pipe, Necessitating Night Lowering Into Trench.

The priming coat sets quickly, usually within two hours if the weather is good, but, in any event, within four hours. A second machine, quite similar to the first, follows and places upon the pipe the bitumastic enamel coating, approximately $\frac{1}{8}$ in. in thickness. The enameling machine is operated by hand simply by turning a crank, which causes it to move along the pipe and it is served with melted enamel supplied from large kettles mounted on wheels, petroleum distillate being used as fuel. The enamel coating after being placed is touched up where required and the company's inspector follows behind and gives it a thorough examination, using a mirror for the purpose of inspecting the lower portion of the pipe.

Following the enamel machine a gang of men equipped with a tripod lowering machine, which has a small hand power winch, lower the pipe into the trench. This machine is provided with a pair of light 4 ft. 6 in. wheels which perform double duty—first making the machine readily portable and second functioning as winch handles. Spot filling is then done every 30 to 40 ft., while the pipe is pried to alternate sides of the trench, so that the pipe lays in a zig-zag manner in the bottom of trench.

Following the operation of spot-filling, a back-filling machine completes the work, removing the material which has previously been standing in a pile alongside the trench and placing it in the trench, neatly piling it over the filled trench. This machine is fitted with a 40 h.p. automobile motor and travels along straddling the dirt pile. The earth moving mechanism consists of a series of flat blades attached



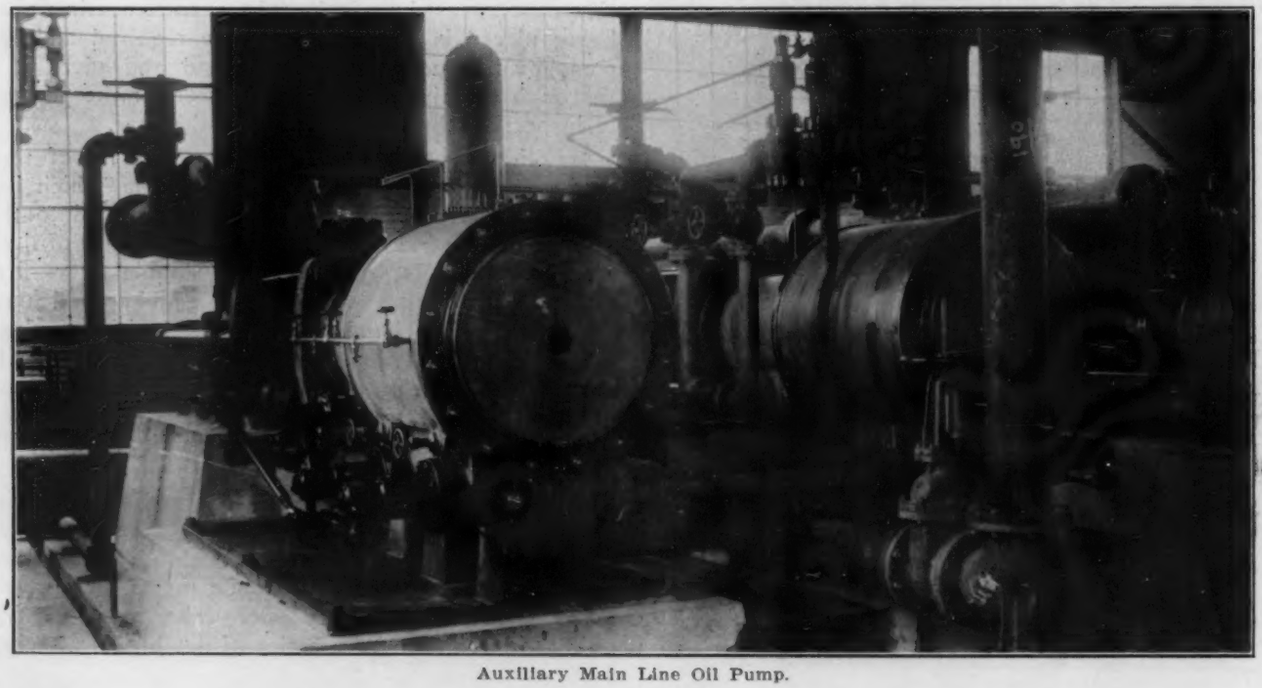
Main Corliss Engine Driven Oil Pump.

to chains which travel transversely to the ditch and move the material from the pile to the trench. A considerable portion of the work was done with ordinary road scrapers, until the back-filling machine was completed.

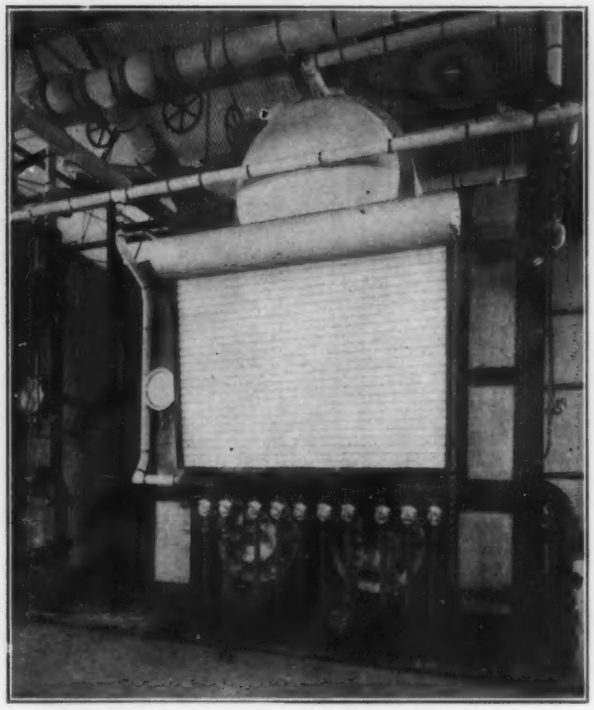
The pipe screwing machine was used on the roughest and most difficult portions of the country and the pipe enameling machines were able to follow wherever the pipe screwing machines could go.

Pumping Stations.

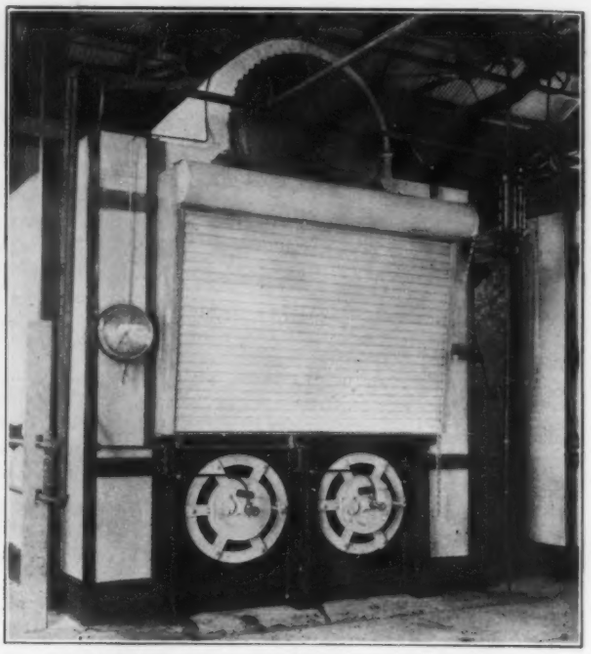
Each of the pumping stations on the pipe line is capable of pumping 1200 bbl. of oil an hour against a pressure of 800 lb. to the sq. in., and has an auxiliary pump capable of pumping about half this quantity in the event of the main pumping unit being shut down for repairs or adjustments. The main pumping unit consists of a 26 and 42 by 36 cross compound Allis Corliss engine direct connected by cross yokes and side rods to a four plunger 6½x36 cast steel oil line pump manufactured by the Columbia Steel Company and Dow Pump & Diesel Engine Company. The engine is a substantial heavy duty machine and is fitted with intermediate receiver and Richardson continuous oiling system. The oil pump has four single acting plungers operating in cast steel cylinders, to each of which are bolted four double valve pots containing two similar valves, one an inlet and the other an outlet valve. The valve seats are of crucible cast steel of the double annular type and the valves are of high grade bronze. The area of the openings is 17½ sq. in.



Auxiliary Main Line Oil Pump.



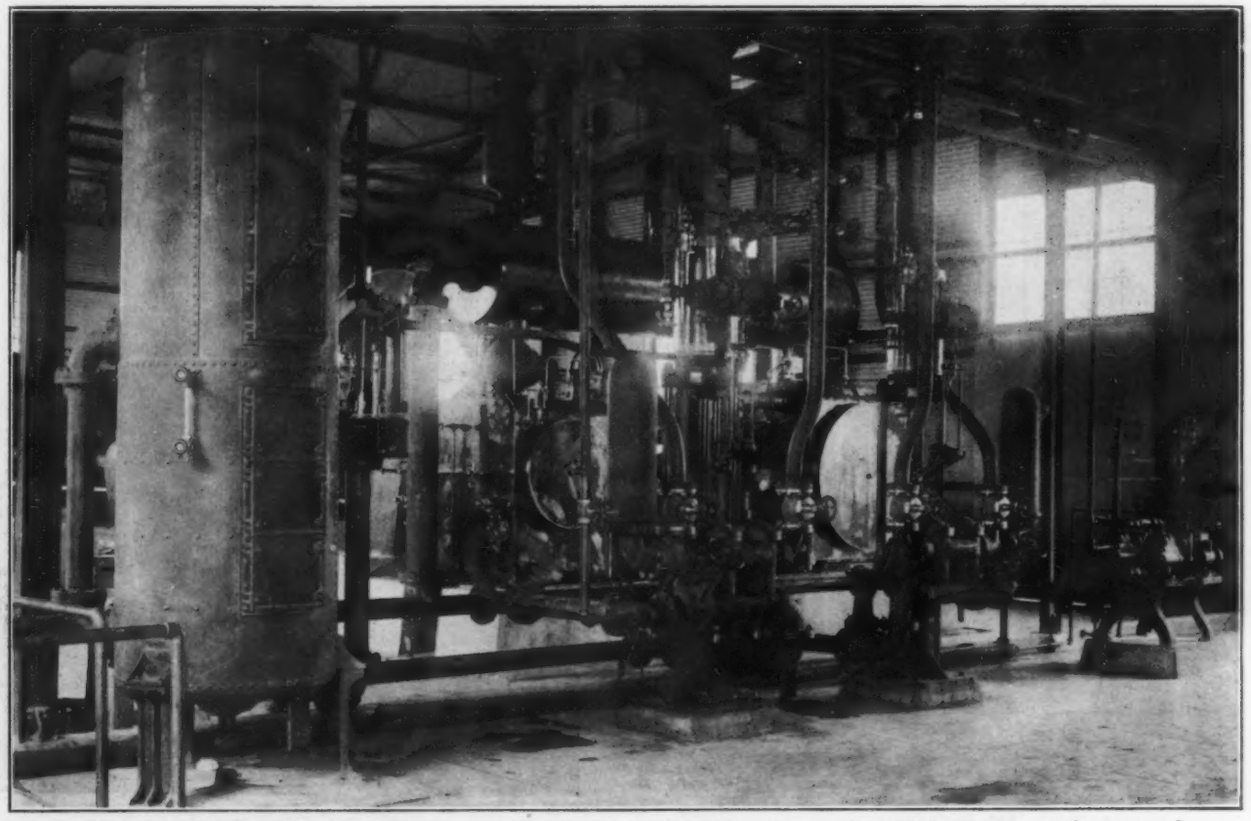
Boilers at Caliola Station Fitted With Oil Burners. and Also With Gas Burners to Use Natural Gas From the Oil Fields.



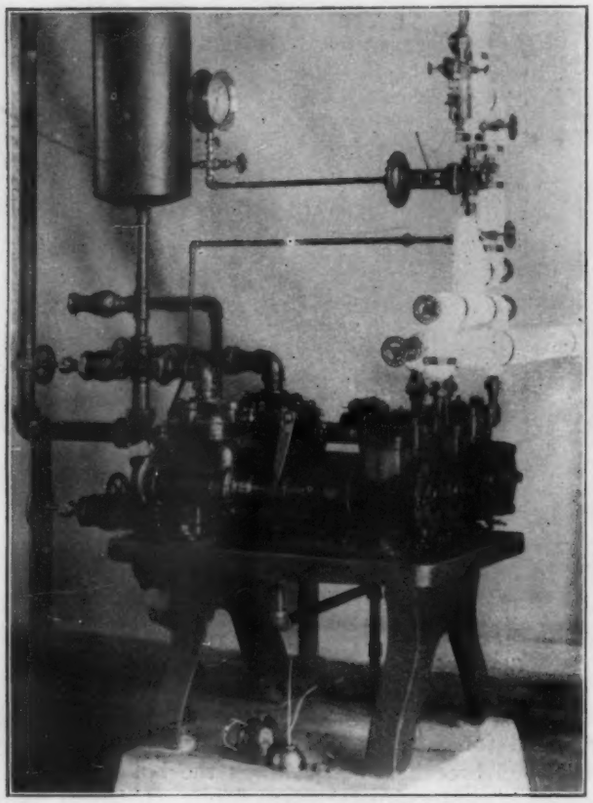
Standard Boiler With Pressure Oil Burners.

and the lift only ¼ in. A central suction manifold of cast iron connects with the suction line from the oil tanks, and the discharge openings of the valve pots are connected to two steel manifolds, which are connected to the pumping main.

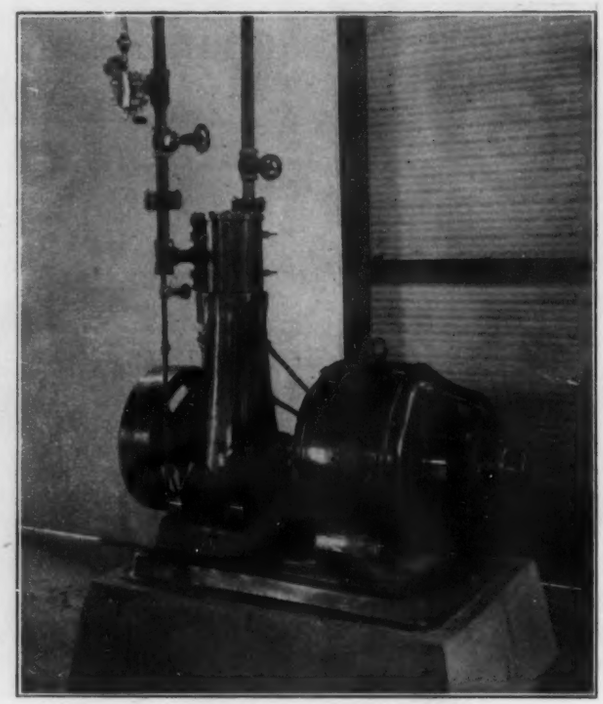
Steam is furnished by two 250 h.p. Heine type boilers manufactured by the Llewellyn Iron Works of Los Angeles, placed in a brick setting with fire boxes arranged for burning oil. A steel stack 70 ft. high with steel breechings discharges the boiler gases. A system of direct pressure burning is used, fitted with oil heaters and burners manufactured by the Coen Company of San Francisco. A set of duplicate pumps handles the fuel oil and furnishes the pressure for operating the burners, the oil being heated in an oil heater using exhaust steam from the pumps and also in a second oil heater on the pressure side, taking



Station Interior Showing Fuel Pumps, Feed Pumps and Feed Water Heater, With Main Engine in Background.

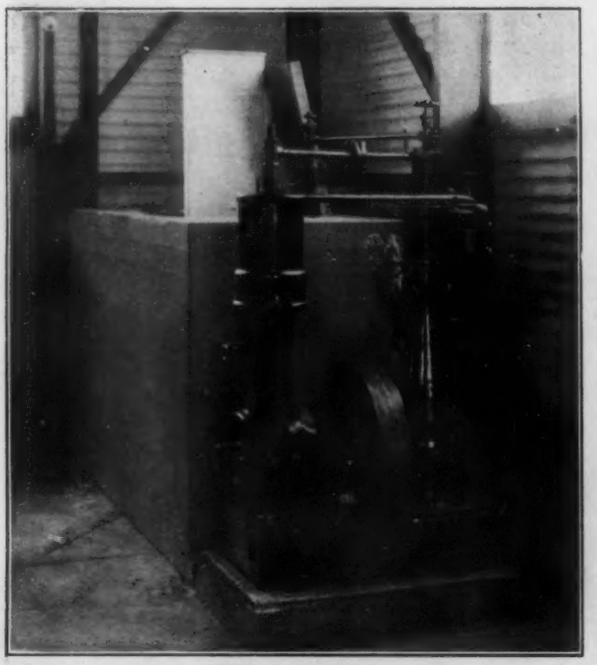


Fuel Pumps.

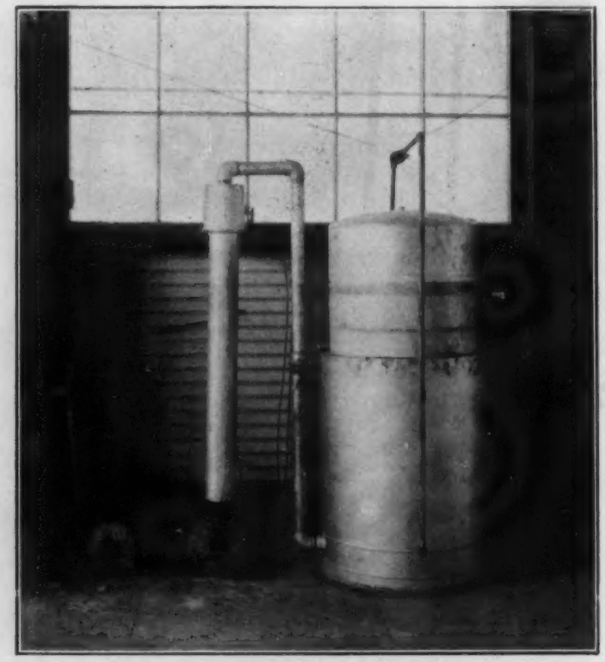


Dynamo for Electric Lights.

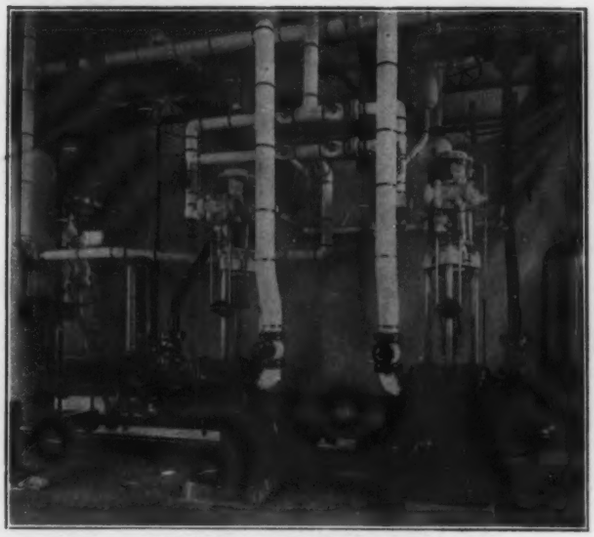
high pressure steam direct from the boilers. Each station is fitted with two 10x7x18 admiralty type vertical feed pumps, with a 6x5x10 hotwell pump and a 6x5x10 general utility pump, all furnished by the International Steam Pump Company of New York. The general utility pump is used for returning oil drips from stuffing boxes, etc., to the main tanks, and for transfer of oil to fuel oil tanks and other miscellaneous purposes. The exhaust steam from the main engines is conducted to two tubular oil heaters outside the station building, which contain about 1100 sq. ft. of heating surface each. They were manufactured by the Schaw-Batcher Company of San Francisco. The condensation from these oil heaters, as well as condensation from other points, is conducted to a filtering hotwell set in a pit in one corner of the boiler room. The hotwells and feed water heaters were furnished by George F. Day of San Francisco, and each is equipped with float operated valves in the steam lines of the pumps supplied by them. Water from the filtering hotwell is discharged to the top of the heater and from the heater is returned to the boilers by the feed pumps. The control of the water is en-



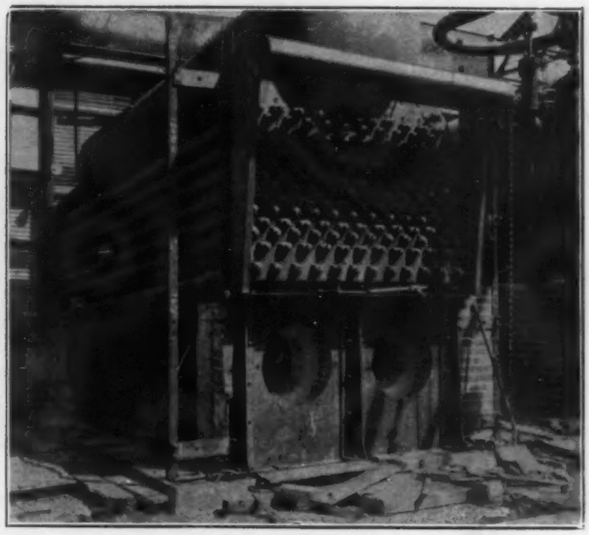
Ice Machine.



Gas Machine.



Admiralty Type Feed Pumps.



Boiler Partly Erected.

tirely automatic and any water collecting in the hotwell is immediately pumped to the feed water heater and thence directly into the boilers by the feed pumps.

In addition to the main line oil pumping engine there is a 16 and 30-7½x24 duplex compound direct acting oil pump also furnished by the International Steam Pump Company, which is fitted with cast steel oil pressure parts, double pot valves similar to the main engine and is capable of pumping from 12,000 to 15,000 barrels of oil daily at 800 pounds pressure.

Each pumping station is fitted with a dynamo of 4 kw. capacity driven by a small reciprocating high speed engine for furnishing electric lights as a measure of economy and safety. There is a small ice machine made by the Cyclops Iron Works of San Francisco for furnishing a supply of ice, which is quite necessary in the hot summer for the comfort of the employes and to preserve their food supplies.

Each of the pumping stations has two water wells. They are from 1400 ft. to but a few feet in depth, depending on the location. The wells at those pumping stations on the southern and more desert portions of the line are quite deep, while those on the more northern portions are shallower.

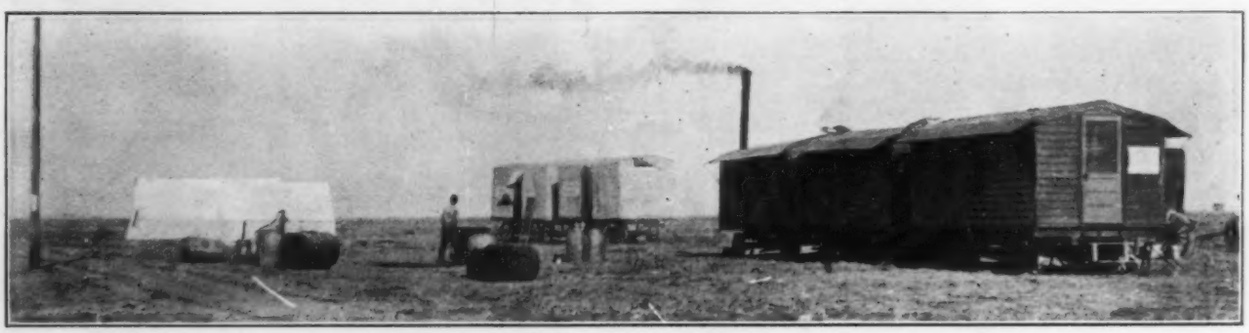
Each pumping station is equipped with two 37,500 bbl. steel oil tanks, which are provided to permit shutting down the machinery for short periods to make necessary adjustments and repairs, and also for the purpose of storage in transit if required. A 1200 bbl. tank was erected to store feed water, and two 100 bbl. tanks for measuring and storing oil to be used for station purposes. A small tank on a tower was erected to keep a supply of domestic water under pressure for service to the employes' cottages and dormitories.

At each station there are three cottages and a dormitory for the employes.

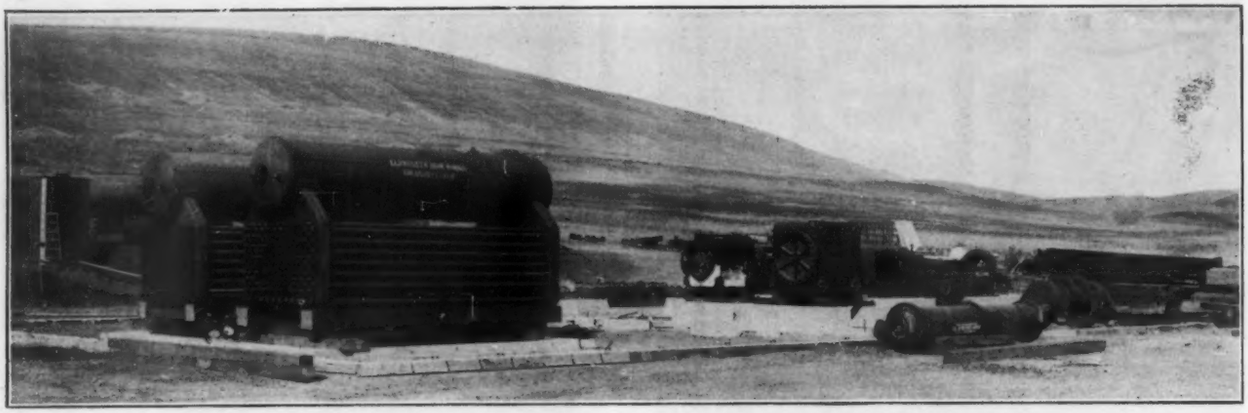
Pumping Station Erection.

The eleven pumping stations on the pipe line are identical as far as buildings and equipment are concerned and vary only slightly in general arrangement to best suit the lay of the ground. A progressive plan of construction was adopted for the erection of the stations and the machinery because of the great economies which could be obtained. This plan was adhered to strictly and gangs of men were organized, such as the pioneer gang, concrete gang, steel erection gang, etc., for the installation of their respective work.

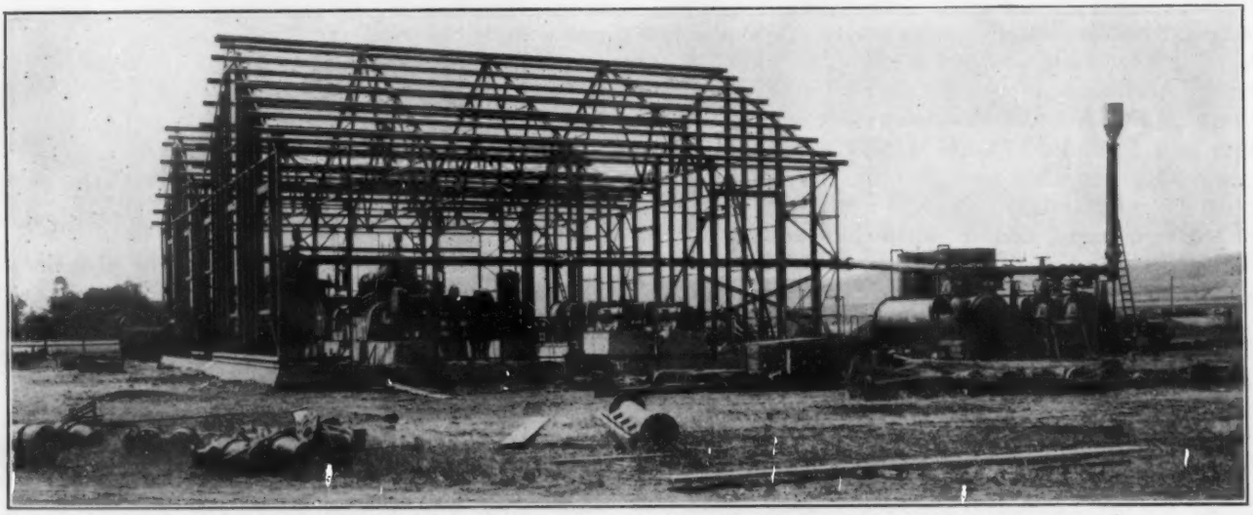
The first work started was necessarily the erection of a camp and provision for a water supply. As the greater portion of this pipe line crosses a barren and desert country in which the water courses dry up within at most three or four days after the rains, the establishment of some of the camps, particularly those on the southern end of the line, was beset with numerous difficulties, and it was necessary to maintain water wagons and haul water for some of the stations, particularly at Cantua, Cheney and Panoche stations until wells could be put down and water obtained. As



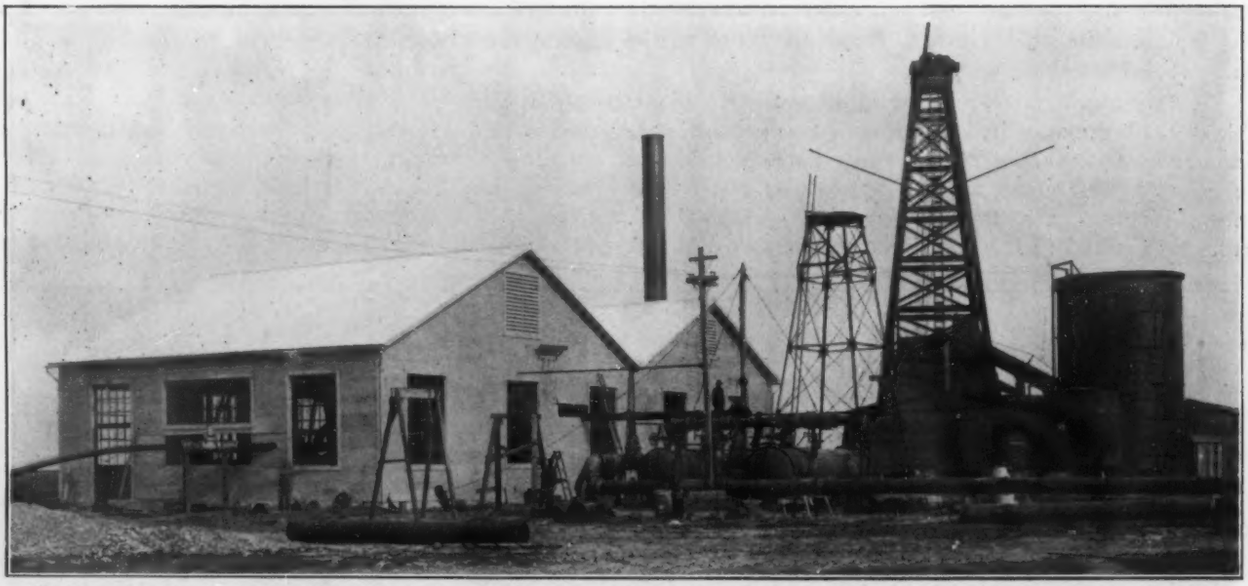
Portable Camp Outfit.



Boilers, Engine Frames, Structural Steel, etc., Delivered at Meganos Pumping Station.



Machinery on Foundation, Oil Heaters and Steel Building Erected at Corral Pumping Station.



Cantau Pumping Station With Corrugated Iron Finished Station Piping in Place and Second Well Being Drilled.

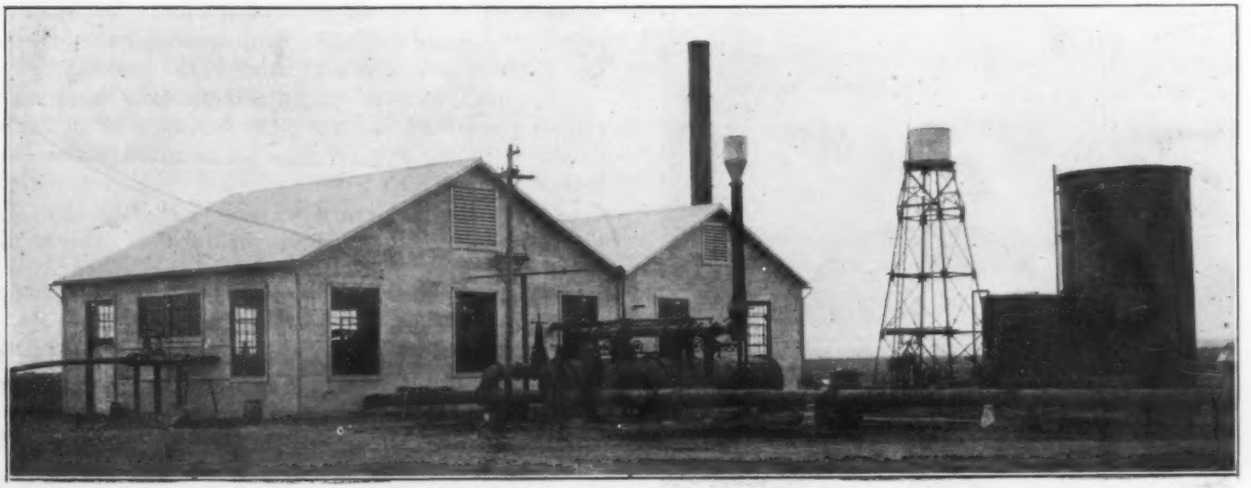
Storage Tanks Completed at Cantua Pumping Station.

the period of construction would be a short one tents were used to house the men and camps were established usually consisting of four tents with wooden floors and wooden frame work for sleeping quarters and one small tent for office and sleeping quarters for foreman and timekeeper. A resident foreman and timekeeper were installed at each pumping station as soon as the camps were erected. Following the pioneer gang a concrete gang placed the concrete foundations for the machinery and pumping station building. Following it came a gang of structural steel erectors who placed the structural steel frame work for the building, erected the steel tower for the water tank and erected the steel smokestacks and breechings. The boilers and such heavy portions of the machinery as were convenient were placed upon the concrete foundations before the steel work was erected. Following this gang a small crew of men applied the corrugated iron sidings, roofs and steel window frames to the buildings and a glazier installed the glass, A large crew of machinists erected the Corliss engine driven main-line oil pump, and the smaller auxiliary main-line oil-pump, and they were usually working simultaneously with the corrugated iron workers. While these progressive gangs did the greatest portion of the heavy work they did not do all of it, as it was found convenient and economical to have the station foreman erect the smaller pumps and most of the steam pipe as soon as he could after the steel structure for the building had been erected; and the station foreman usually managed to get this work in and completed about the time the machinists' crew finished the erection of the main engines. Following the completion of the main pumping engines a small crew of machinists with a capable operating engineer then took charge and steam was gotten up, the station foreman usually having previously dried out the boiler brick work, and the engines were turned over, valves adjusted and everything put in readiness for operation.

The work of drilling the wells was usually started simultaneously with the opening of camp and this work was carried on by contractors and completed as fast as possible, depending upon the difficulties encountered and the depth to which the wells had to be drilled.

The steel oil storage tanks at the stations, as well as a water tank for storing feed water, were furnished under contract by the Lacy Manufacturing Company of Los Angeles and they had a large crew of erectors, averaging from ten at first up to twenty at later stages of the work, who erected these tanks following the same progressive plan, that is starting at the southern-most station and working forward from station to station. This was a contract of considerable magnitude and included twenty 37,500 bbl. oil tanks, twenty-two 100 bbl. fuel tanks, eleven 1200 bbl. water tanks and eleven steel towers, making 70 carloads of steel and 16 carloads of lumber for the roofs; total 86 carloads, approximately 2500 tons.

After the pumping stations had been tested and the work approached completion numerous small details of no great moment, but requiring attention, still remained and these were taken care of by a final clean-up gang consisting of one or two men of each trade,



Sandport Pumping Station Completed.

Fifty Mules Hauling 13½-Ton Boiler.

which started at the southernmost station finished everything there, and working steadily northward from station to station fully completed the whole of the work still remaining.

Hauling.

Conditions encountered on the pipe line were in many respects peculiar. The soil on the southernmost portion of the line is quite light and very sandy and on the northern portions of the line it consists of tough black adobe soil, with the exception of a small amount of rock in the vicinity of Mt. Diablo.

While Caliola pumping station was but four miles from the nearest railroad station, Cantau, Cheney and Panoche were almost 20 miles from railroad stations, and the remainder of the stations averaged from 10 to only a few miles, so that the average distance of all of they was 9½ miles.

The lessons learned during the reconnoissance survey, however, that during the rainy season the roads became almost impassable for automobiles, were remembered, and when hauling was started dependence was placed in the main upon the use of the old reliable mule, although the company purchased two motor trucks, one of two ton capacity and the other three-quarter ton capacity. On the southernmost portions of the line it was found that large size motor trucks were useless in the wet season, and on account of the sandy soil and numerous stream crossings were unable to carry more than half their rated load at other times. The lighter trucks did very well, and proved valuable. For general service Ford cars were used, no fewer than eleven being in service throughout the job.

Ford Cars Were Used.

Materials were hauled from the railroad stations using as a general practice teams consisting of eight mules and two wagons, with one driver. Depending upon the condition of the roads these outfits were loaded at the rate of 1000 to 1600 lb. per animal, and were required to average twenty miles per day. At times during the wet season it was necessary to reduce loads, but an average of 1200 lb. per animal were carried throughout the work.

Materials began to arrive about the first of October and hauling was continued steadily until all the materials were delivered in August of the following year, with only an interruption of about thirty days in the middle of the rainy season. Special efforts were made to get delivery of the heavy boilers and oil heaters for use in the stations in the desert portions of the line, and four boilers and four heaters were hauled in before the rains commenced in January and advantage was taken of a dry spell about the first of March to haul in four more boilers and four more heaters.

The boilers weigh 13½ tons, and the oil heaters 13 tons, and these were hauled on wagons made up by using two of the largest size heavy wagons with 4½ in. axles, one ahead and one behind, with the boiler suspended between on two 10x12 timbers, the illustration clearly showing the arrangement. If the roads were in ordinary condition, 28 head of mules were found sufficient to handle the boilers with ease, and this number was used regularly for hauling both the boilers and the oil heaters. This outfit was controlled in the standard Western manner with a jerk rein and the usual outfit consisted of a driver, an assistant ordinarily called a swamper, and a third man, usually a driver of some experience, who attended to the steering of the rear wagon and handled the brakes.

As the season advanced and the rain came special efforts were made to move the boilers and oil heaters to the pumping station sites so as to have these materials on hand to permit of construction work proceeding during the rainy season. The hauling of boilers was continued even in the face of threatening weather. With the falling of rain the softened roads became badly cut up by the traffic and the last boilers moved required 50 head of mules. Usually 26 of these were strung out on the main chain ahead of the boiler hauling rig and 12 pulled with an auxiliary chain attached to one side of the boiler and 12 with an auxiliary chain to the other side.

The hauling of the boilers on the narrow road through Marsh Creek Canyon up to Marsh Creek sta-

Twenty-eight Head Hauling 13-ton Oil Heater Showing Double Wagon Arrangement.

tion (No. 11) and the controlling of the twenty-eight head used on this work required the greatest skill, and although the road was very narrow in places, just sufficient for the outfit to pass, two boilers, two oil heaters and three engine bed plates were hauled without the least difficulty or mishap, in spite of the many turns which had to be made.

The pipe was hauled as a rule with eight mules, although there were some heavy wagons available capable of carrying loads which required twelve mules to haul. These outfits were usually started in groups of eight or ten teams, which would start from a railroad station early in the morning, make a trip to the pipe line, deposit their loads and return to the railroad station by nightfall. Seven hundred and twenty was the maximum number of mules used at any one time and the average number used through a period of a number of months was about six hundred. These were all supplied under contract with H. J. Brandt of Bakersfield, who also furnished the drivers and all the equipment for hauling. A total of 48,000 tons was hauled, including construction materials, subsistence and supplies, aggregating 512,000 ton miles, at a cost per ton mile considered very satisfactory, particularly as a considerable portion of the work was done during the rainy season.

Timekeeping.

The timekeeping on the pipe line extending over 170 miles of line and also the accounting for all the teams furnished by the contractor was an important job and was handled by a paymaster with from 15 to 18 timekeepers.

A timekeeper was stationed at each of the pumping stations and timekeepers were stationed with the telephone construction crew, the pipe screwing crews, etc., and a traveling timekeeper was located on the railroad who took care of the transient labor employed by the material clerks for unloading materials. The timekeepers in addition to their duties at the pumping stations also acted as receiving clerks for materials delivered there.

Each timekeeper carried a payroll and issued discharge checks in the usual manner, there being another signature, usually that of the station foreman, in addition to that of the timekeeper. The payrolls were turned into the office at the end of the month and incorporated into a payroll covering the whole of the work, which was found to be a necessary precaution to avoid duplications and more than paid for the necessary additional work involved. The paymaster paid off all the men on the pipe line by check once a month, making a trip over the whole of the pipe line for this purpose. A feature of the timekeeping which possibly is novel was the use of a clearance statement issued to men moving from one timekeeper's jurisdiction to another, of which a great deal was done due to the movement of the various gangs of skilled workmen. This clearance statement was found a great convenience and also removed any chance of friction or misunderstanding, as a man on leaving one station was able to know exactly how his account stood and have any errors or adjustments attended to before he left.

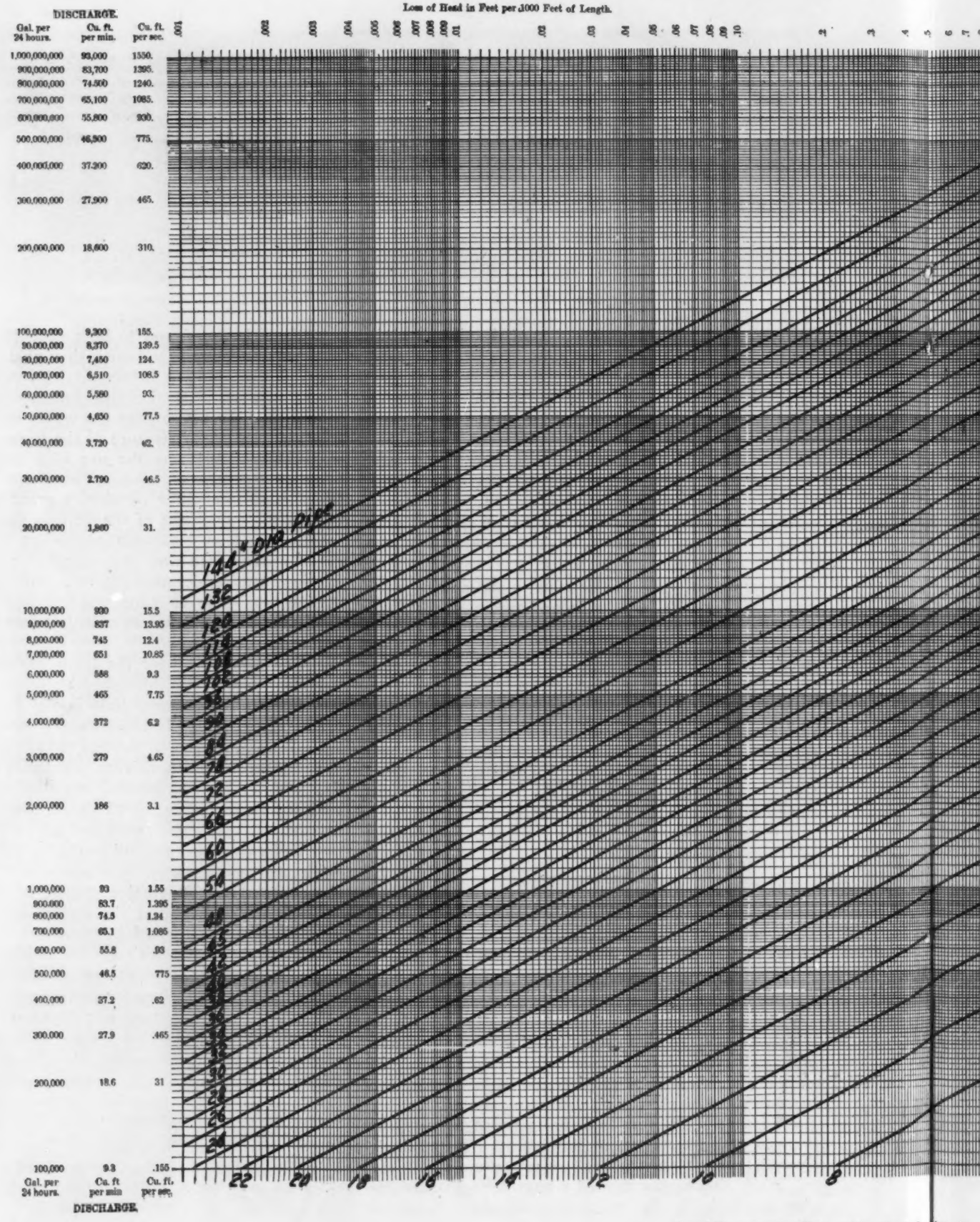
The accounting for the large numbers of mules, wagons, drivers, etc., furnished by the contractor was based upon the teaming bills issued by the material clerks at the railroad stations and other points, and a payroll was prepared at the end of the month in which the number of mules, drivers, wagons, etc., used each day was set forth on parallel lines and the whole carried out to the proper total to pay the teaming contractor. A timekeeper, provided with a Ford automobile, so he could get around promptly, attended to this work, and was assisted by a timekeeper furnished by the contractor. The major portion of the work was done jointly, so that at the end of the month only small differences existed between the company's account and the contractor's account, which were always settled promptly by referring to the teaming bills covering the transactions for that month.

Specifications and Purchases.

Pipe and machinery were purchased after the receipt of tenders upon specifications prepared for each particular article and the greater portion of the materials required for the construction of the pipe line were covered by contract. In addition supplies were purchased locally, principally in the San Francisco market.

The purchase of materials was attended to by an engineer purchasing agent, and copies of his orders were furnished to the material clerk at the destination, one copy which he retained and the second copy which he returned upon completion of the shipment of materials covered by the order. With these signed copies

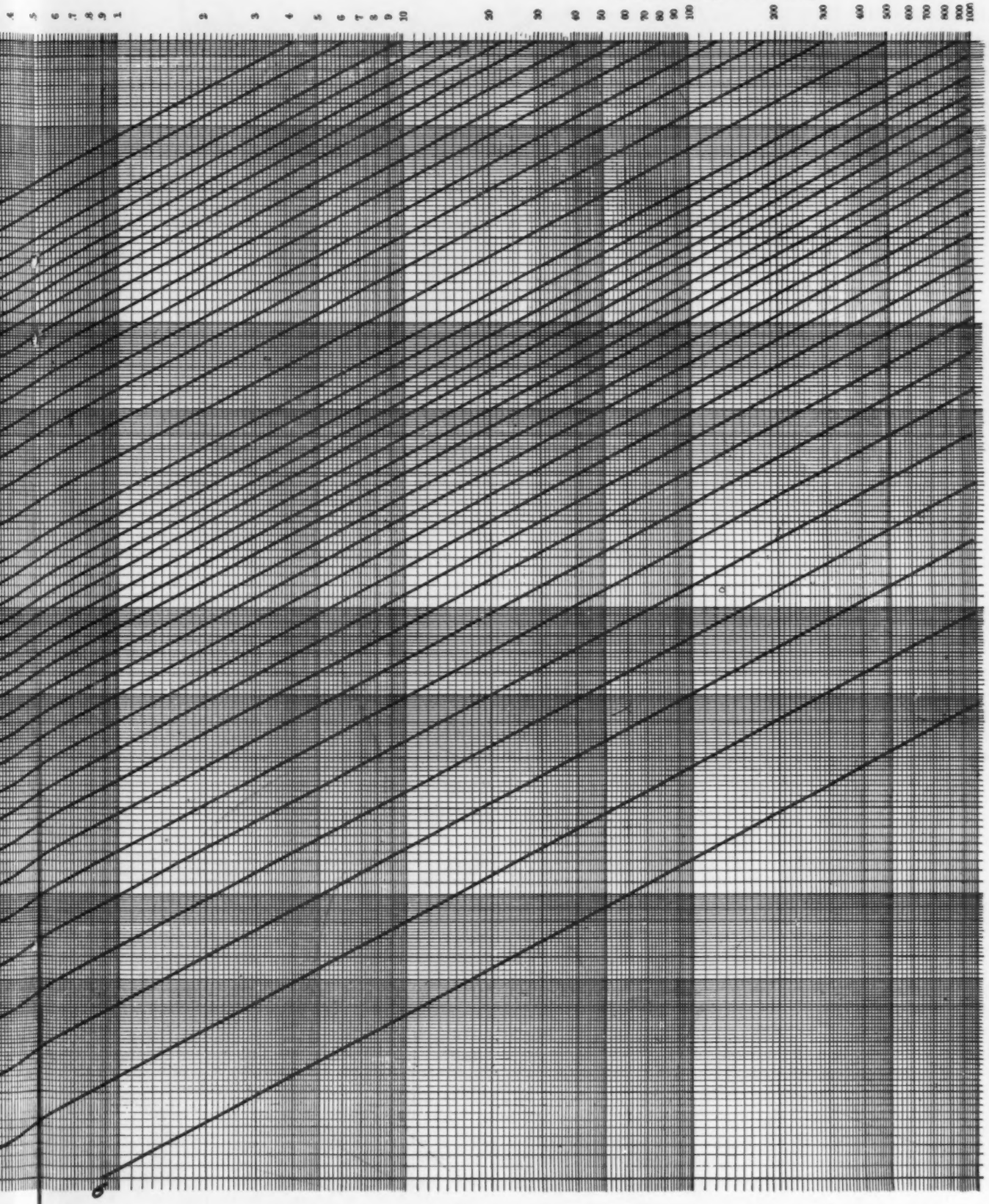
CHART FOR GRAPHIC DETERMINATION OF FLOW OF



C = 100, corresponding with riveted pipe in

FLOW OF WATER IN PIPES BY HAZEN & WILLIAMS FORMULA. PREPARED BY GEO. J. HENRY.

Loss of Head in Feet per 1000 Feet of Length.



reted pipe in which deteriorations have well started.

Suspension Bridge Pipe Crossing at Panoche Creek.

and the receipts furnished by the material clerks, all invoices received in the office were checked and approved for payment.

The contracts were covered by engineers' certificates issued monthly or upon completion of definite portions of the work.

Commissary.

A contract was entered into with the D. J. Desmond Commissary Company to furnish meals to all employees of the company, and, complying with this contract, the Desmond Company erected at each of the pumping stations a kitchen, dining room and storage facilities and furnished meals to the employees. In some cases they used portable houses, which could be easily set up and taken down, and in other cases used tents with wooden floors and sides.

For the telephone construction crew, pipe screwing crew and for the crew of the contractor applying the enamel coating, the Desmond Company furnished portable commissary outfits, consisting of three wagons, one wagon being fitted up with stove and other facilities for kitchen purposes, and the other two wagons fitted as dining rooms and having also considerable locker space for the storage of supplies. These portable dining outfits were convenient and were easily transported from place to place as the work progressed, so much so that the pipe screwing crews moved camp usually every two days. Twelve semi-permanent and three portable dining outfits were maintained on the work, together with the necessary transportation facilities for furnishing supplies and for supervision. The maintenance of the commissary department by a separate contract was found to be of the greatest convenience, as it permitted the engineers to devote their whole attention to the construction work and entirely relieved them of the necessity of supervising commissary and the multitudinous details connected therewith. This same method had previously been used upon the Los Angeles aqueduct, and the excellent results obtained there were repeated on this work. The meals supplied were satisfactory, and but little or no complaint was ever made by the men.

Telephone.

Material for the telephone line was obtained at the beginning of the work and the line constructed as soon as possible, which was found to be of the greatest importance and assistance in the matter of intercommunicating between the pumping stations and in supervising the work. The telephone line consists of two No. 9 B. & S. medium, hard drawn copper wires, supported

Panoche Creek Suspension Bridge.

on 25 ft. round cedar poles, the bases of which were treated with avenarius carbolineum. The poles were spaced 200 ft. apart, and Brookfield No. 44 glass insulators, which are similar to those used on the most important long distance telephone circuits, were used. This telephone line extends from the office of the California Oilfields, Ltd., at Oilfields, to the Caliola Pumping Station, and thence through each of the pumping stations to the refinery at Martinez. It is approximately 200 miles long.

A leased circuit was obtained from the Pacific Telephone & Telegraph Company and the telephone line extended from the refinery to the offices of the company in San Francisco.

In addition, a simplex circuit was arranged over the two telephone wires of the Pipe Line Company's telephone line, and telegraph instruments installed at San Francisco, Martinez and Oilfields. The pipe line operations are controlled by a despatcher located at Oilfields, who is in communication with all the pumping stations by telephone and with the refinery at Martinez and the offices in San Francisco by both telephone and telegraph.

THE DENVER WATER CONTROVERSY.

BY GEORGE M. BULL.

(This straightforward account of the water situation at Denver should be illuminating to engineers in other Pacific Coast cities who are struggling with similar difficulties. The author is a consulting civil engineer at Denver.—The Editor.)

The Denver Union Water Company is the owner of the water rights and physical property which now furnishes the city of Denver with practically its entire water supply. In 1890 a water franchise was granted by the city to extend over a period of 20 years, and terminating in 1910. Since that time the water company has been operating without a franchise, and is serving the city until such time as their property may be acquired by purchase or a new plant and water supply is provided in some manner by the city.

In 1907 an agreement was entered into by the water company and the city for an appraisement of the plant and properties, including the water rights owned by the company. This appraisement was to form a basis for purchase or a new franchise. The result was that a report was made in 1909 jointly by the engineers representing both the city and water company, which fixed the value of the water company's properties at some fourteen million dollars.

This appraisement was not satisfactory to an organization known as the Citizens' Association, who then proceeded to secure an independent unofficial appraisement of the plant, securing for the purpose a new board of engineers. This appraisement fixed the valuation of the property of the water company at about $8,000,000 (not including water rights). The result was that at a following election the purchase of the property at the $14,000,000 appraisement was rejected and no arrangements were entered into with the water company for either the purchase of its property or the granting of a new franchise for future operations. This election also created a utilities commission for the purpose of either constructing a new water plant or purchasing that of the Denver Union Water Company, and also authorized for either of those purposes an issue of eight million dollars in bonds.

This resulted in the Denver Union Water Company entering a suit against the city, the purpose of which was to compel the city to grant the company a new franchise or purchase the property at the valuation given by the original appraisal board, which was $14,000,000. This suit continued in the courts until 1912, when a decision was rendered by the Supreme Court of the United States which sustained all the contentions of the city which, summed up briefly, were that the Denver Union Water Company had no right to continue in operation under the franchise that had terminated; that it could not compel the city to grant it a new franchise and that the city was at liberty to construct an entirely new plant and secure entirely new water rights, if it saw fit to do so, and the present water company would be compelled to go out of business.

After this decision had been rendered by the Supreme Court, an association of the business men of Denver, known as The Retail Dealers' Association, secured from the water company a tentative agreement setting out for what price the company would be willing to sell its properties to the city, and under what conditions the company would accept a new franchise, the important conditions being the fixing of water rates at 10 per cent less than those under the franchise that had expired should a new franchise be granted, and the purchase of the property by appraisement which, under no conditions, was to exceed $14,000,000.

An election was held, and the terms of this agreement were not accepted by the people.

The utilities commission then proceeded in detail to make an independent appraisement of the Denver Union Water Company's properties, a board of engineers being appointed for that purpose. The finding of this appraisement was a valuation of some $10,000,000, (not including the present value of water rights).

The city commissioners then passed an ordinance lowering the rate of the water company approximately 20 per cent below those under the expired franchise. This action of the city commissioners caused the water company to enjoin the commissioners against enforcing this reduction of rates.

A new appraisement has been made by the Federal Court for the purpose of fixing the rate at which water should be furnished by the water company until such period as the plant shall be purchased by the city or a new plant constructed for service.

It is expected that the decision of the Federal Court as to what the rates should be, together with an appraisement of the properties will soon be made. There will then have been four independent appraisements of the Denver Union Water Company's property.

Since its creation, the utilities commission has been unable to dispose of any of the bonds of the eight million dollar issue and has been practically powerless to do anything in connection with determining whether or not the new plant should be built or the present water company's properties purchased, and the problem is apparently no nearer a solution now than at the beginning of the controversy six years ago.

The water company is of course uncertain as to its future and must operate its plant accordingly. A large majority of the people in Denver are intensely partisan, either for or against the water company, and it is impossible for them to see any merit in the contentions of the side to which they are opposed, and they seem to be blind to the fact that there should be some ground that is fair to all concerned on which to settle the matter to the credit of both sides, and for the relief of Denver. There are other issues involved in connection with serving Denver with water that are more important than the details of building a new water plant or the price that should be paid for the old plant.

Denver and the surrounding community is now going through a period of depression that always follows the development of large resources where a lack of co-operation dissipates the resources developed and produces conditions of apparent overdevelopment.

With Denver and the surrounding country this is due principally to the great complexity of the development of the water supply of the Platte River and adjacent streams and the lack of a united administration of the same for the common good in accordance with the priority of use.

The direct flow of the Platte River and its tributaries has been appropriated for irrigation for many years, the last system of any size under reasonably successful operation having a priority of 1879. Between that date and 1900 very little additional land was placed under irrigation.

Beginning about 1900 many large and conflicting interests commenced the development of the flood water supply of the Platte River and its tributaries by storage. Without considering numerous large systems constructed on the tributaries of the main stream which, because of their joint priority rights, affect the storage supply available on the main stream there is now a total of two and one-half times as much land placed under irrigation from the Platte River in the vicinity of Denver as was irrigated by the direct flow of the stream up to 1900, and the water supply that has been developed is not more than 50 per cent in excess of the direct flow of the stream.

The results that have been obtained from the developments made under present conditions of operation have been that a large percentage of the acreage irrigated from flood waters has received only a partial supply, and some lands no supply at all. Millions of dollars have been expended and the apparent losses have materially affected conditions in Denver.

To a very great extent the present deplorable conditions can be removed by a central control of storage supply that will utilize the unused capacity of the water company combined for united operation with the reservoirs on the Platte River in private ownership.

The water company's storage reservoirs at present and for many years to come will be only be called upon for a minor part of their capacity in supplying the city and operated in unison with those constructed by others for irrigation storage would control efficiently all the supply available for both the city and agricultural needs and would in addition furnish capacity for the control of the supply of the later direct flow priorities for more efficient irrigation service.

The great problem that confronts Denver today is the economical and proper regulation of the use of the water resources that make the prosperity of the city possible, and under existing circumstances the only solution is for the city to use its moral and financial support in making the control and administration of these resources economical and efficient, and to so combine the storage developments above Platte Canon as to control that supply of the Platte River. This can never be accomplished unless the organization furnishing the water supply for the city of Denver also includes the larger field of irrigation supply as well.

The people as a whole must be brought to realize that in the appropriation of water for beneficial use the entire community must fix the standard of economy and method of use in order that a fair return may be obtained from resources upon which the prosperity of all depends. If necessary the state constitution should be amended to make possible the development of the Platte Valley by the aid of the city of Denver along the lines here outlined.

Viewing the situation at Denver from this standpoint, the controversy between the city and the water company is a minor issue, providing that its settlement will guarantee that the Denver water plant in the future will enter the larger field of operation to furnish not only the water supply to the city but storage water facilities and additional water rights for the unsuccessful developments surrounding Denver. For the present water company or the city itself to continue to furnish water for the city only and not supply storage water for irrigation will mean that the present undeveloped condition around Denver will continue. If the water company can more readily do this than the city, it should be granted a fair franchise for continued operation under these conditions. If this cannot be arranged, the city should certainly take upon itself the responsibility not only of furnishing the city with an adequate water supply, but should develop all the water resources available that are necessary to make the agricultural country surrounding Denver prosperous.

What Denver needs at this time is a united effort on the part of all to so develop and use the surrounding resources that the city will have a prosperity founded on the agricultural success of the adjacent country. When this has been accomplished the cost of water service in Denver will take care of itself.

MUNICIPAL HIGH FINANCE.

Many municipalities of Washington are watching Olympia in its financial campaign. The city now has a heavy bonded debt and recently, through condemnation proceedings secured the right in the Pierce county Superior Court to take over the plant of the Washington Public Service Company. The jury in the case, the suit being transferred from Thurston to Pierce county on a change of venue, awarded the company but $88,500 for its property. The city is to pay the company in bonds, the revenues of the plant being pledged for that purpose, the voters having authorized an issue of $90,000 for that purpose. Now the city wants to put in a municipal lighting system. With a heavy general bonded indebtedness out, with its moral backing behind the water revenue bonds it might be difficult to float new bonds. Therefore the city proposes to get a street lighting system under the plan of creating a local improvement district and assessing the cost to the abutting property. Already the water company has declined to make any more extensions of mains and in a new paving district the residents find they are to pay for the water mains in front of their property. The council recently created three additional local improvement districts so that the property could be taxed with this cost. In the meantime Olympia is without street lights and the charge is made that the street lighting money was used in the water case litigation. The situation is a most interesting one and the people of the state, particularly public officials, are watching the progress of events with much interest.—Capital Record.

BUILDING GOOD WILL FOR THE POWER COMPANY.

BY E. B. CRIDDLE.

(This straight-from-the-shoulder talk on how the employes of an electric power company can improve relations with the public goes to the very heart of the matter. While it is written with particular reference to the conditions of the Southern Sierras Power Company, for which the author is general agent, it is applicable to every company in the West, The Editor.)

Though our mechanical and electrical system, the plant as a whole, from the lakes or reservoirs on through the power houses, transmission and distributing lines to the delivery points, is one of the most efficient, economically constructed and operated systems to be found in this or any other country; though our engineering department has successfully pioneered in many details of construction, boldly stepping into fields but lightly touched theretofore, and risking success or failure on the wisdom of its judgment; though the success of our long transmission and other innovations has proven the soundness of the judgment of our people, and other engineers have been glad to follow the paths blazed by us; though in supplying energy to our customers, the interruptions have been few and the voltage well regulated, so that our mechanical and electrical apparatus is known to be good and effective, yet all these are utterly valueless without good salesmanship and service. Of what use are power houses and transmission lines, unless we sell the energy so generated?

In this salesmanship, this "service" of which we hear so much and which converts the melting snows of the Sierras into golden dollars through the medium of ripened grain, green alfalfa fields, red apples and golden oranges, gold and silver mines and manufacturing plants teeming with industry, as well as the lighted streets, business blocks and homes of prosperous cities, many things enter, all having to do with our dealings with the public, securing and holding customers; for keeping a satisfied customer is quite as important, and often more difficult, than securing him in the first place. Then, too, we must have the confidence and good will of the public at large, as well as of our actual customers. There is a great tendency on the part of certain natures—those who make agitators and socialists and trouble breeders—to stir up antagonism toward all utilities, to be baiters of successful business, and it is our work to counteract this influence, to make friends and to provide "service."

How is this to be done? Who is to do it? The commercial department? The commercial department, yes, insofar as it can, but the commercial department is only one small factor in this great work, which must be accomplished through coherent, intelligent, well directed teamwork by all those who have to do with the great public, from the president to the youngest office boy or newest lineman.

Having a plant ready for service, we have only started our work. I will briefly consider a few of the more important things which must yet be done in order to provide that service.

Rates: Our wares (electrical energy) being attractive and desirable, we must offer suitable and attractive rates which will yield a fair return to the company upon its investment, on the one hand, and be commensurate with the value of service, on the other. More than nineteen centuries ago, the principle was announced that the laborer is worthy of his hire, and this principle is fully established; the enterprising financiers who invest their money, their time, business experience and wisdom are well entitled to such rate of return upon the money invested as would be derived from other successful large enterprises in the same community, and in addition are entitled to such recompense for efficient business management as might accrue to them if their services were applied in the successful management of other enterprises of similar magnitude. These conditions, added to the physical cost of operation, taxes, maintenance and depreciation, establish the cost of service.

The rates charged various classes of customers are governed partly by the value of the service as well as by the cost. Regardless of cost of production, if rates are made higher than the cost of satisfactory service from other source, the wares remain unsold. This does not mean, always, that actual competitive costs must be met from the standpoint of dollars alone, but all things must be considered, character of service as well as cost, must govern. For example, no one hesitates to pay more for electric light than for tallow candles; it is worth more; and in providing power for large enterprises, the convenience and adaptability of electricity are considered as well as actual money cost, in comparing with oil, gas or steam. With desirable rates, we need

Salesmanship: This requires, first, a thorough understanding of the possibilities of electricity and of the rates, a knowledge of the needs of the customers, the cost and inconvenience of other sources of light, heat or power and the ability to present these facts in a telling and convincing manner to the prospective customer; to figure out for him just the kind and size of installation he should make, whether for light, heat or power, and to indicate, as well, proper operating conditions to secure the best and most satisfactory results at the lowest possible cost. Coupled with this must be a pleasing personality, absolute integrity and truthfulness, with unfailing courtesy and patience, and a certain personal magnetism which will lead a prospective customer to have confidence in the judgment and statements of the salesman. These qualities must be possessed and exercised alike by the local superintendent and the commercial agent or power salesman whose field is limited to securing contracts.

Courtesy: The same unfailing spirit of courtesy, integrity and absolute fairness which is so essential in the make-up of the salesman, is equally necessary in each individual representative of the company who in the slightest way comes in contact with the public. No one representative of the company plays a larger part in moulding the public opinion of the company and its policies than the local superintendent, who is its personal representative in his particular territory. His attitude toward the public is accepted by that public as the attitude of the company. It is impossible that the general office shall have a close personal touch with the many individual customers over a scattered territory such as we serve; so in

selecting and retaining superintendents, great care must be exercised to secure men who understand the operations of the system in the locality they serve, who possess the attributes of salesmanship, who are "mixers" big enough to take an active part in all the public developments and enterprises of their several territories, and who will see to it that the employes under their direction are always corteous. This spirit of true courtesy must be exercised by the office boy, the telephone operators and clerks in every office, the linemen, as well as by the officials of the company, and is evident in the very tone of voice and manner, showing the caller—whether customer or not—all due respect and deference, a pleasant smile, a willingness to go out of your way to supply information or to put him in touch with the proper representative of the company for discussing the particular business in hand.

Promptness in answering letters and in pushing all business to a conclusion is very important. Letters should never be brusque. Know your subject and present it briefly, clearly, courteously, convincingly. Remember that the other man has a right to his views, which are entitled to respect. A dictatorial tone makes no friends for yourself or your company.

Adherence to Rules: The fact that you are at all times the representative of the company, and part of a great machine, must never be lost sight of. The rules of the company, whether covered by general or special orders, executive orders, departmental orders, letters or verbal instructions, must be rigidly adhered to. These rules are carefully considered and lay down a general line of conduct as do the laws of a city or state, and must not be transgressed; but within the prescribed bounds lies great latitude for the development and exercise of individual personality. Make friends, get the business and hold the business, within these bounds. A man's work is judged by the effective results. A large percentage of customers and prospects consider their conditions to be exceptional, and that they should be allowed some concession of some sort. It is necessary to have a sufficient grasp of all the facts, to be able to convince such parties that their conditions are covered by the rules and rates already in effect; that the company's rules in the case are reasonable and fair; that under utility regulations exceptions are not permitted. Not that "the commission says we cannot charge such a rate," for the commission says nothing of the kind, but the law says we cannot discriminate. It may be that on some particular point the commission has ruled as to what constitutes discrimination, and if such point is raised, it may well be stated that the commission has so ruled. If in doubt as to the proper application of a rate or a rule, before taking sides with a customer or committing the company to a given policy, the matter should be taken up with the proper authority for a decision; and if necessary, in order to strengthen your own statement to the customer, such authority may be quoted.

When there comes a matter of controversy with a customer over any point, it is not enough to arbitrarily announce the company's view or rule, perhaps leaving a sting difficult to remove, but such persuasion as you possess must be used to convince him that the company is reasonable and just in its action. In no case may a representative of the company take sides against the company, trying to create the feeling that the man is all right, but the company all wrong. Whenever any employe of the company, whether his position be high or low, feels that he is not in harmony and full accord with the administration, that he cannot stand for the rules and practices of the company, and afford loyal support to those under whose orders he works, it is time for such employe to seek new fields of action.

Loyalty—Co-operative Teamwork: This quality has already been slightly touched upon, but needs to be elaborated. Success can never be achieved by the company without the absolute loyalty of its people in all things, and by coherent teamwork; nor by the individual who will not, or cannot, adapt himself to such teamwork. As well expect a boat crew or football team to win a race or game with each man working according to his own ideas. Jealousy between departments is intolerable. No department can absorb all the responsibilities and authority or the judgment and wisdom of the organization; each has its own function and few men reach the head of a department without having first learned that important fact. Our company seems entirely free from any trouble of this sort; the heads of our departments are all seeking the company's welfare and letting personal glory take care of itself; and I am glad to find a strong desire for teamwork on the part of most of the employes whom I know.

And right here I will say that a personal acquaintance between all the officials and all other employes is very desirable. It is the policy of the company, so far as possible to fill all higher vacancies by promotion of those whose ability and experience best qualify them to fill such vacancies and a knowledge of the qualifications of the employes we have is of great help in making such promotions.

The employe who applies himself, first filling the position he holds a little better in every respect than it was ever filled before, and then to preparing himself to fill the next higher position, is very apt to achieve such higher position when the time comes. Patience, perseverance and competence win. There is a limit to the salary any position may pay, but long and efficient service, even in one position, has usually received the recognition of increased income over the starting point, and all have before you the hope of deserved promotion. What the company wants is the best man for the place, with the hope always of finding such a man in the ranks of the force we already have.

Efficiency: The term "efficiency," as applied in this connection, and in commercial and industrial activities generally, implies a thorough application of intelligent effort, securing in the highest degree effective results. Not always, merely the best one can do, for the energy must not be misapplied; a square peg rarely fits a round hole; a first class stenographer might often be a poor blacksmith. The material used, the workman selected, must be capable and adapted to the service, and must then use his brain, his skill and energy to accomplish the greatest volume of his best work in a given time. It is unnecessary to

elaborate on this. Incompetent, stupid or lazy employes have no place in our organization. Intelligence, capacity, industry and enthusiasm are essential and will win success for the individual and for the company.

Service: Finally, to sum up the foregoing details; in providing "service," after having a plant as good as can be constructed, we must then have

First—Suitable rates.
Second—Good salesmanship.
Third—Courtesy.
Fourth—Adherence to rules.
Fifth—Loyal teamwork.
Sixth—Efficiency in all departments.
Seventh—And finally, the inevitable result of the combination, "SERVICE."

We deliver energy with a minimum of interruptions, use ball bearings and flexible joints to eliminate, as far as humanly possible, all friction between employes themselves, as well as between the representatives of the company and the public at large, cultivating a cordial, friendly relationship of mutual respect and trust with that public, so that they will know that, beginning with the watchman at the reservoirs, all the way down through the system, each employe recognizes his responsibility to give the best he has of wideawake, intelligent effort to deliver the goods; that the interest of the public is our interest; that no trouble is too great to secure for our patrons the best service money can buy; that we are an integral part of each community we serve, with much money invested, and are as deeply interested in the welfare and upbuilding of that community as any other citizen or property owner there; that we are reasonable and fair in our charges and dealings and believe in, and practice, the rule of live and let live, with fairness to all and oppression toward none. These things, to my mind, constitute "Sierras Service."

Consumers deposits for telephone companies have been abolished by the Washington Public Service Commission. The commission's order permits telephone companies to collect bills in advance and discontinue service when a bill remains unpaid. The companies are also permitted to collect two months in advance when a telephone is installed.

No true rubber substitute—that is, no material possessing all the properties of rubber—has yet been produced. Synthetic rubber is identical in composition, etc., with the crude rubber, and so can not be called a substitute. It is not yet produced on a commercial scale. There are a number of so-called substitutes, however, that may be mixed with rubber to advantage in the production of certain articles. The oil substitutes are of two kinds, namely, white substitute, produced by mixing corn, rapeseed and cottonseed oils with sulphur chloride, and brown substitute, made by heating any of the above oils with sulphur. The so-called mineral rubbers are either natural products, such as gilsonite, elaterite, etc., or the crude tar residue remaining after the distillation of petroleum. These substitutes are extensively used in the cheaper grades of insulated wire.

ELECTRIC COOKING AT PORTLAND.

The Northwestern Electric Company and the Portland Railway, Light & Power Company of Portland, Oregon, are actively engaged in a campaign for promoting electric cooking in that city.

The Northwestern Electric Company is making the following rates, with the electric range connected to the regular light meter.

1/3 of the connected lighting load = max. demand.
Max. demand × 100 = W.H. use.
The first 10 kw.-hr. costs 8 cents.
The second 70 kw.-hr. costs 7 cents.
Next 1000 kw.-hr. costs 3 cents.
Excess above this costs 2 cents.
No maximum demand figured less than 200 watts.

A hot water heater is connected up if desired, on a flat rate of $2.10 per month for a 600 watt heater and $2.60 per month for a 750 watt heater, or in other words, 3.5 mills per watt of capacity. The heater is arranged on a double throw switching system so that the water heater can only be operated when the range is not in service.

The Portland Railway, Light & Power Company is installing a separate meter for electric ranges and charge a 3-cent rate. It is also contemplating allowing a rebate for the four winter months, during the time furnaces are run in residences and hot water is available from this heat. The electric water heater charge is the same as the Northwestern Electric Company and the manner of connection and use also similar.

The cost of the electric range and water heater furnished by the Northwestern Electric Company is as follows:

List price of the electric range, plus $23 (for any capacity heater from 450 to 750 watts) = total expense of installation. Payments as follows: Ten per cent down and balance in 10 equal monthly payments. This price includes all electrical and mechanical connections.

The mechanical equivalent of light has been experimentally determined as 0.00162 watt per lumen. It is regarded as the most fundamental quantity in the establishment of light measurement on a physical basis.

A bureau of sanitary engineering has been established at the University of California with C. G. Gillespie as chief engineer. The bureau will investigate domestic water supply and sewage problems of various towns with the especial object of preventing typhoid fever.

Electrical household devices in use are estimated at eight million, according to figures compiled by the Society for Electrical Development. This includes over three million irons and one and a half million fans, nearly a half million vacuum cleaners and toasters. Figures on other devices are as follows: Disk stoves, 234,883; washing machines, 212,082; grills, 114,267; percolators, 106,278; heaters, 76,925; heating pads, 67,107; chafing dishes, 29,316; ironing machines, 28,000; ranges, 14,140; teapots, 6,397; radiators, 3,190; dish washers, 261.

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CONTENTS

The Shell Oil Pipe Line 161
By H. W. Crozier.

Chart for Determination of Flow of Water in Pipes 176
By Geo. J. Henry.

The Denver Water Controversy 179
By Geo. M. Bull.

Municipal High Finance 180

Building Good Will for the Power Company 181
By E. B. Criddle.

Consumers' Deposits 183

Rubber Substitutes 183

Electric Cooking Rate at Portland 183

Mechanical Equivalent of Light 183

Bureau of Sanitary Engineering 183

Electrical Household Devices 183

Editorial 184
A Great Engineering Achievement.
Engineering Economics.
The Engineering Congress

Personals 186

Book Reviews 186

Publications Received 187

Program for A. I. E. E. Panama-Pacific Convention 187

Trade Notes 188

News of California Railroad Commission 188

News of Idaho Public Utilities Commisson 188

New Catalogues 188

News Notes 189

A Great Engineering Achievement

Peculiar interest is always associated with the manner in which a great engineering feat has been accomplished because each engineer realizes that he may be called upon for similar work at some future time. Consequently the leading article of this issue dealing with the methods employed in building the great Shell oil pipe line is particularly valuable as a record of engineering achievement.

The most noticeable feature of construction is the efficient manner of its accomplishment. It is an object lesson of how organization and scientific management anticipates the most petty detail so that each part of the work proceeds without interruption or delay because of the unreadiness of labor or material at another part. The work was characterized by the machine-like precision and prevision with which it was undertaken. Nothing was done without a careful preliminary consideration of every possibility upon which the final decision as to the best methods to be used was based.

The most unique feature of the construction was in the substitution of machines for duties usually performed by hand. The pipe was screwed by machines, given a protective cover by machines, and lowered by machines into machine-dug trenches, which were afterward filled by machines. The ingenuity of these devices and the efficacy of their work suggest their adoption in many similar lines of construction, especially in irrigation work.

A notable exception to the general rule of using machines, however, was demonstrated in the use of mules for hauling. This humble and much-maligned beast, "without pride of ancestry nor hope of posterity," proved invaluable in transporting materials.

The paper contains useful suggestions on several matters frequently overlooked but upon which much of the success of a job of such magnitude depends. These are the methods of time-keeping and of commissary supply, both of which are essential to getting the most efficient service from men.

Engineering Economics

The papers for International Engineering Congress, complete in so many respects, are lacking in the most important element of modern engineering. Little or no attention is given to the great subject of engineering economics, the business of engineering, and the science which determines the success or failure of every engineering undertaking.

At one time designing was the most important part of an engineer's work. New conditions had to be met by new methods. But as time goes on methods and machines are becoming more and more standardized, so that originality in design is not so important. Engineers are still constructors and operators.

Their efforts in handling men and materials are responsible for the success of every engineering job.

But above all else engineers should be business men. They are working for results. No matter what the technical perfection of their suggestion it must meet the test of cost. Cost defines the limitation of engineering design, construction and operation.

Cost is so closely associated with wealth, for with excessive costs there can be no wealth, that the engineer is continually forced to recognize it as the determining factor in his work. The men at the head of the engineering profession today are essentially business men. They are called upon to prepare contracts and specifications more frequently than to design substations. The designing is done by subordinates while the chief is concerned with the business side of the undertaking.

The busy engineers of the day are those evaluating the work of former days. The trend of the times requires that an engineer know the value of a piece of construction. Whether the valuations are for the purpose of financing or rate-making, their basis is invariably economics.

The question arises as to whether it is possible to put new wine into old bottles, whether the engineer can assimilate the additional knowledge which is necessary to cope with these new duties. It usually has been accomplished by a course of general absorption of business knowledge. But would it not be better to add a course in economics and eliminate some other courses from the all ready over-crowded curriculum of engineering instruction?

This has been done by a few colleges, especially those requiring five years of study before a degree is given. In such a course it is not necessary to discuss the abstract theories of political economy but merely to outline the economic basis of engineering construction.

No further justification of the need for greater knowledge of engineering economics need be cited than the well known fact that the estimates of engineering construction are usually less than the final costs. While this may be partially explained by the pioneer character of much of the work, such an excuse is no longer tenable in these days of accurate cost and performance records.

Accounting, both financial and cost, is a subject upon which many an engineer is woefully ignorant. If for no other purpose than the ability to interpret financial statements every engineer should acquire a knowledge of the fundamentals of accounting. The progress of the future is based upon the records of the past.

Engineering and economics have one point in common in that they are both based upon mathematics. Engineering economics is largely a matter of applied mathematics. Consequently, as the engineer is a man well grounded in mathematics he experiences little difficulty in grasping the fundamentals of economics and applying them to his problems.

The Engineering Congress

The program for the sessions of the International Engineering Congress which is to convene at San Francisco September 20-25, gives a comprehensive list of papers by some of the world's most famous engineers. As the honorary president of the congress is General G. W. Goethals, who will preside in person, and as this meeting celebrates the completion of the greatest engineering feat of history, the Panama Canal, many papers deal with this subject.

Next in importance is the subject of waterways and irrigation, thirty-four papers having been prepared. There are twenty-two papers on municipal engineering, twenty-four papers on railway engineering, twenty-five papers on materials of engineering construction, twenty-five papers on mechanical engineering, fourteen papers on electrical engineering, fourteen papers on mining engineering, thirty-four on metallurgy, twenty-five on naval architecture and marine engineering, five papers on aviation, three on refrigeration, four on agricultural engineering and engineering education, three on ventilation and one on scientific management. The detailed list of many of these papers was published in the preceding issues of this journal, while others appear elsewhere in these columns.

Engineering practice is so interlocked that specialists will find papers of value to them under other general headings than that subject upon which they are specializing. Thus electric railways are treated under municipal engineering and railway engineering, Diesel engines under marine engineering and electrochemistry under metallurgy.

Of course the greatest benefit will accrue to those who can personally attend the sessions of the congress, but as all the papers and discussions are to be published at a nominal price in a series of volumes dealing with the several headings, the proceedings of this congress will constitute the best epitome of engineering progress during the past decade which has ever been assembled. We consequently cannot urge too strongly the advantage of membership in the congress as these volumes will be available only to members. The present membership of three thousand would be quadrupled within the next few weeks if these facts were fully understood.

As the congress is to be held immediately after the conventions of the several national engineering societies at San Francisco many in attendance thereon will undoubtedly also attend the congress. September is particularly pleasant in the Exposition city whose many attractions make this an opportune time to visit it.

PERSONALS

F. C. Finkle, consulting engineer of Los Angeles, is at San Francisco.

M. O. Leighton, consulting engineer of Washington, D. C., is at San Francisco.

L. E. Sperry, superintendent of the N. Y. Insulated Wire Company, is at Los Angeles.

W. I. Otis, representative of the Detroit Fuse & Manufacturing Company, is at Seattle.

Wm. Baurhyte, vice-president of the Los Angeles Gas & Electric Company, is at San Francisco.

L. M. Chapman, engineer of tests, Westinghouse, Church, Ker Company, New York, is at San Francisco.

E. W. Lloyd, president of the National Electric Light Association, is expected at San Francisco this week.

S. Z. Mitchell, president of the Electric Bond & Share Company, was at San Francisco during the past week.

W. Brewster Hall, Pacific Coast manager for Pass & Seymour, will spend the next three weeks at Los Angeles.

John R. Freeman, consulting hydraulic engineer of New York, is visiting the Panama-Pacific International Exposition.

C. M. Swan, general manager of the acoustical department H. W. Johns Manville Company, New York, is at San Francisco.

W. E. Coman, vice-president and general manager of the Northwestern Electric Company, Portland, Oregon, is at San Francisco.

F. G. Baum, consulting engineer at San Francisco, left this week for a trip to Alaska where he will inspect the Speel River project.

G. W. Sherman, stores manager of the Western Electric Company, San Francisco, is on a business trip to Portland and Seattle.

F. H. Leggett, Pacific Coast manager of the Western Electric Company, San Francisco, is on a business trip to Portland and Seattle.

E. R. Davis, general manager of the Pacific Light & Power Company, has returned to Los Angeles after a brief visit to Northern California.

G. Purvis, representative of the Hurley Machine Company, San Francisco, is making a business trip to Los Angeles and Southern California.

W. S. Hanbridge, secretary of the California State Electrical Contractors' Association, is making a trip through the Santa Cruz mountain region, California.

L. J. Vander Naillen, manager of the Oro Electric Corporation, San Francisco, returned recently after a trip through the Lake Tahoe region of California.

S. P. Russell, in charge of the electrical department H. W. Johns Manville Company, San Francisco, is on a business trip through Southern California.

C. C. Thomas, professor of mechanical engineering at Johns Hopkins University, Baltimore, Md., and inventor of the Thomas electric gas meter, is at San Francisco.

A. E. Rowe, sales manager of the Telephone Electric Equipment Company, San Francisco, returned during the week from a business trip through the Sacramento Valley.

E. M. Cutting, manager of the Edison Storage Battery Supply Company, San Francisco, Cal., is making a business trip through Oregon, Washington and the Pacific Northwest.

B. B. Beckett, formerly storage battery engineer with Pierson, Roeding & Company, has been appointed electrical engineer for the Goldfield Consolidated Mine at Goldfield, Nevada.

W. F. Zimmermann of the credit department Electric Railway & Manufacturers' Supply Company, San Francisco, has severed his connection with that company. **H. E. Mylett** will assume his duties.

F. O. Broili, industrial engineer for the Northwestern Electric Company, Portland, Oregon, has been appointed on the membership and editorial committees of the National District Heating Association.

P. Longan, controller of the Mt. Whitney Power & Light Company, Visalia, Cal., who has been confined to the hospital for some time past, is on the road to recovery and expects to return to his office in the near future.

Dr. Thomas C. Addison, Pacific Coast manager General Electric Company, is making an eastern trip, in the course of which he will attend the annual convention of the Association of Edison Illuminating Companies.

J. W. Thompson of the H. W. Johns Manville Company, San Francisco, has been transferred to the Los Angeles office of the company, where he will devote his time to the electrical department of that company's branch.

B. Smith, of the San Francisco office of the Edison Storage Battery Supply Company, San Francisco, has been transferred to Detroit, Mich., where he is to have charge of the office recently established in that city by the Thos. A. Edison Company.

Robt. Sibley, formerly professor of mechanical engineering at the University of California and at one time editor of this journal, is acting in the capacity of consulting engineer for Frank M. Wilson of Berkeley, California, on several important projects.

W. D'A. Ryan, chief of the department of Illumination, P. P. I. E., San Francisco, who recently underwent an operation at San Mateo, Cal., for appendicitis, is rapidly recovering from the effects of the operation and expects to assume business duties within the next couple of weeks.

OBITUARY.

Max Hebgen, vice-president and general manager of the Montana Power Company, with headquarters at Butte, died at the Presbyterian Hospital, Chicago, August 24th, after a long illness. Mr. Hebgen was prominent in the electrical industry, and was closely associated with H. M. Byllesby in the inception and formation of what has become the Montana Power Company, one of the large hydroelectric systems of the United States.

BOOK REVIEWS.

"Standard Handbook for Electrical Engineers," Frank F. Fowle, editor-in-chief; fourth edition; 1984 pp.; 4x6½ in. Published by McGraw-Hill Book Company, New York, and for sale by Technical Book Shop, San Francisco. Price, $5.00.

The fourth edition of this well-known standard handbook constitutes practically a new book, because of the rewriting and enlargement which changes in the art have made necessary since the third edition in 1910. The book is divided into twenty-five sections, each written by an authority, and presenting information of essentially a practical nature. The arrangement of this subject matter is logical and facilitates easy reference, particularly by the use of the thumb tabs. The text is notable for the completeness of its bibliographies and references to more extended discussions of the subjects treated. A notable new addition is the section on engineering and central station economics.

"Electrical Measurements and Meter Testing." By D. P. Moreton; 328 pp.; 4x6½ in.; limp cloth binding. Published by Frank J. Drake Co., Chicago, and for sale by Technical Book Shop, San Francisco. Price $1.00.

This text is essentially a working manual for practical men who understand little about electricity. The first five chapters explain the fundamental principles of electricity, and the remaining eight chapters are devoted to calculation and measurement of resistance, current and pressure, construction, operation and testing of wattmeters, watthour meters and other indicating and recording instruments. The author is well known as a writer, having the knack of making intricate subjects clear, and while the book is in no sense as complete as the "N. E. L. A. Meterman's Handbook," it contains sufficient information to teach the average meterman the how and why of meter connections.

PUBLICATIONS RECEIVED.

The U. S. Bureau of Standards has issued a third edition of Circular No. 38 on "The Testing of Rubber Goods," describing the methods used in the bureau's laboratory. Scientific Paper No. 248 gives results of the determination of the specific heat and heat of fusion of ice. No. 251 gives determinations of wave lengths in the iron spectrum.

PROGRAM FOR A. I. E. E. PANAMA-PACIFIC CONVENTION

The sessions of the Panama-Pacific convention of the American Institute of Electrical Engineers will be held in the Native Sons of the Golden West building, San Francisco, Cal., September 16, 17 and 18. Headquarters will be at the St. Francis Hotel. Joint sessions with the American Electrochemical Society and the Institute of Radio Engineers have been arranged.

The following program of papers has been announced, parallel sessions being held on Thursday and Friday.

Thursday, 10:30 A. M.

"Physical Limitations in Direct-Current Commutating Machinery," by B. G. Lamme.

"Automatically Controlled Substations," by E. W. Allen and Edward Taylor.

Marine and Lighting Session.

"Standard Marine Electrical Installations," by H. A. Hornor.

"Recent Improvements in Electric Lighting of Steam Railroad Cars," by R. C. Lanphier.

2:30 P. M.

Three parallel sessions will be held, as follows:

Electrophysics Session.

"The Effects of Transient Voltages on Dielectrics," by F. W. Peek, Jr.

"Arc Phenomena," by A. G. Collis.

"Experimental Researches on Skin Effect in Conductors," by A. E. Kennelly, F. A. Laws, and T. H. Pierce.

Valuation of Public Utilities Session.

Symposium on Inventories and Appraisals of Properties.

Part I, by C. L. Cory.

Part II, by W. G. Vincent.

Part III, by W. J. Norton.

These papers will be supplemented at the session by contributions from other members of the committee on inventories and appraisals of properties.

Joint Session with the Institute of Radio Engineers.

"Sustained High-Frequency High-Voltage Discharges," by Harris J. Ryan and Roland G. Marx.

Friday, September 17, 10:00 A. M.

Two parallel sessions will be held, as follows:

Telephony and Telegraphy Session.

"Submarine-Cable Rapid Telegraphy: Ocean and Intercontinental Telephony," by Bela Gati.

"Automatic Switchboard Telephone System of Los Angeles," by W. Lee Campbell.

"Continuation of Discussion on Inductive Interference." Introduced by joint committee on inductive interference.

Mine Work Session.

"Diesel Engines for Generator Drive," by Charles Legrand.

"A Large Electric Hoist," by Wilfred Sykes.

"The Modern Electric Mine Locomotive," by Graham Bright.

2:30 P. M.

Three parallel sessions will be held, as follows:

Joint Session with the American Electrochemical Society.

"Overhead Electrolysis and Porcelain Strain Insulators," by S. L. Foster.

"Corrosion of Copper Wireless Antennae," by L. W. Webb.

"Electrochemical Possibilities in California and on the Pacific Coast," by J. W. Beckman.

Transmission Session.

"Delta-Cross Connection of Transformers," by G. P. Roux.

"Harmonics in Transformer Magnetizing Currents," J. F. Peters.

"Phenomena Accompanying Transmission With Some Types of Star Transformer Connections," by L. N. Robinson.

"Abnormal Voltages in Transformers," by J. Murray Weed.

"Calculation of Short-Circuit Phenomena of Alternators," by N. S. Diamant.

Joint Session with the Institute of Radio Engineers.

"Radio Development in the United States," by Robert H. Marriott.

The other national engineering societies will be holding meetings at the same time. The American Socety of Mechanical Engineers will meet in the same building, but will have headquarters at the Clift Hotel. The American Society of Civil Engineers will meet at the St. Francis Hotel. The American Institute of Mining Engineers will meet at the Bellevue Hotel.

International Engineering Congress.

These meetings precede the International Engineering Congress, which will meet during the week September 20 to 25, in the new Civic Auditorium. Over 3000 members have already been enrolled in the congress.

The membership fee is $5.00, and should be sent to W. A. Cattell, secretary, Foxcroft building, San Francisco. Members are entitled to one volume of the printed proceedings free; other volumes can be secured by purchase, there being 11 in all.

Sessions of the congress devoted to electrical engineering will be held on Thursday morning and afternoon and on Saturday morning. The following papers will be presented:

Electrical Engineering.

"Economics of Electric Power Station Design," H. F. Parshall, D. Sc., member Institute Civil Engineers, London, England.

"The Water Power of Sweden," Sven Lubeck, president Svenska Tekoforeningen, Stockholm, Sweden.

"Electric Power in Canadian Industry," Charles H. Mitchell, C. E., member Institute Civil Engineers; member Canadian Society Civil Engineers; member American Society Civil Engineers; consulting engineer to Dominion Water Power Branch, Department of the Interior, Toronto, Canada.

"Industrial Effect of Low Cost of Electric Energy," L. A. Ferguson, past president American Institute Electrical Engineers, Commonwealth Edison Company, Chicago, Ill.

"The Effect of Hydroelectric Power Transmission Upon Economic and Social Conditions, With Special Reference to the U. S. of America," Frank G. Baum, member American So-

ciety Civil Enginers; member American Society Mechanical Engineers; member American Institute Electrical Engineers, San Francisco, Cal.

"Electrical and Mechanical Installations of the Panama Canal," Edward Schildhauer, Fel. A. I. E. E.; member A. S. C. E.; member A. S. M. E.; formerly electrical and mechanical engineer Panama Canal Commission, New York, N. Y.

"Electric Welding," C. B. Auel, member American Society Mechanical Engineers; director: Standards, Processes and Materials, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

"The Application of Electricity to the Heating of Metals," F. L. Bishop, member American Institute Electrical Engineers, dean School of Engineering, University of Pittsburgh, Pittsburgh, Pa.

"The Electric Motor as an Economic Factor in Industrial Life," David B. Rushmore, member A. I. E. E., A. S. M. E., A. I. M. E., A. S. C. E.; chief engineer power and mining department, General Electric Company, Schenectady, N. Y.

"The Influence of the Electric Motor on Machine Tools," A. L. De Leeuw, member American Society Mechanical Engineers, Elizabethport, N. J.

"Effects of Electrolysis on Enginering Structures," Albert F. Ganz, M. E., member American Society Mechanical Engineers, professor of electrical engineering, Stevens Institute of Technology, Hoboken, N. J.

"The Mechanical Problem of the Electric Locomotive," G. M. Eaton, member American Institute Electrical Engineers; engineer railway division, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

"On the Production of High Permeability in Iron," Ernest Wilson, William Siemens, professor of electrical engineering, King's College, London, England.

"Electric Illumination," S. H. Blake, member American Institute Electrical Engineers; supply department General Electric Company, Schenectady, N. Y.

Mechanical Engineering.

"Power Plant Design," H. S. Putnam, consulting engineer, member American Institute Electrical Engineers, New York, N. Y.

"The Internal Combustion Engine of the Year 1915. The Gas Power System. A Survey of Its Status in the Year 1915," Professor Chas. Edward Lucke, member American Society Mechanical Engineers, Columbia University, New York, N. Y.

"The Development of the Construction of Turbines in the Netherlands," D. Dresden, w. i., mechanical engineer for Messrs. Gebroeders Stork & Co., Hengelo, The Netherlands.

"The 1915 Turbine," E. A. Forsberg, Stockholm, Sweden.

"The Diesel Engine in America," Max Rotter, member American Society Mechanical Engineers, chief engineer Busch-Sulzer Bros. Diesel Engine Company, St. Louis, Mo.

"Developments in Modern Water Turbine Practice," Dr. H. Zoelly, Society Swiss Engineers and Architects, Zurich; Ver. D. Ing.; Schiffbautechnische Gesellschaft; Inter. Electrotechnical Commission, London; Escher, Wyss & Co., Zurich, Switzerland.

"Water Wheels of Pressure Type," Arnold Pfau, member American Society Mechanical Engineers, Milwaukee, Wis.

"Hydraulic Power Development and Use," J. D. Galloway, member American Society Civil Engineers, San Francisco, Cal.

"Water Wheels of Impulse Type," W. A. Doble, member American Society Mechanical Engineers, San Francisco, Cal.

"Canadian Hydraulic Power Development," Charles H. Mitchell, C. E., member Institute Civil Engineers; member Canadian Society Civil Engineers; member American Society Civil Engineers; consulting engineer to Dominion Water Power Branch, Department of the Interior, Canada.

"The Boiler of 1915," Arthur D. Pratt, assistant to advisory engineer, The Babcock & Wilcox Co., New York, N. Y.

"Compressed Air in the Arts and Industries," W. L. Saunders, president American Institute Mechanical Engineers; member American Society Mechanical Engineers, American Society Civil Engineers; president Ingersoll-Rand Co., New York, N. Y.

"Equipment, Processes and Methods for Boiler Shop," E. C. Meier, Phoenixville, Pa.

TRADE NOTES.

On October 1, 1915, an amendment to the present electrical ordinance of Los Angeles is to become operative, making conduit, armored cable or metallic moulding construction obligatory in all buildings excepting houses used exclusively as residences.

Drake-Clapp Electric Company of Los Angeles have been awarded a prize in the window display contest just concluded by the Rice Leaders of the World Association for exhibit of the products of the Simplex Electric Heating Company. The Southern Electric Company of San Diego was also awarded a prize for its showing of Robbins & Myers motors.

The Electric Railway & Manufacturers' Supply Company is gradually occupying its new quarters at 36-38-40 Second street San Francisco. The factory department has entirely transferred from its old quarters and the store and office department are being moved as fast as possible and with the minimum interruption to business. The new quarters comprise a six story and basement building and affords ample opportunity for expansion and the expeditious handling of the supply company's rapidly growing business.

NEWS OF IDAHO PUBLIC UTILITIES COMMISSION.

The commission has approved the form of contract for electrical energy between Wm. T. Wallace, receiver for Great Shoshone & Twin Falls Water Power Company, and the Electric Investment Company. The commission has also approved form of contract for air heating service from Great Shoshone & Twin Falls Water Power Company from October 1 to June 1.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Western States Gas & Electric Company of Stockton has filed with the commission a supplemental application for authority to sell $74,000 face value of bonds and deposit the proceeds in a special fund used for extensions, additions and betterments to the plant after April 30, 1915. The company asks also for an order approving its expenditures for this purpose during May, 1915, and for authority to sell $10,000 of bonds.

The commission has issued an order authorizing the Tuolumne Electric Company to issue for less than a year promissory notes totalling $12,559.10. These notes are in lieu of notes issued without the authority of the commission. The Tuolumne Electric Company reports losses of $8740 in 1913, and $6725 in 1914. Negotiations for sale to a power company are pending.

NEW CATALOGUES.

Busch-Sulzer Bros. Diesel Engine Company have issued a well-illustrated pamphlet describing unusual features of the waterworks at Appleton, Wis., including the intake, filtration results and results of economical Diesel engine operation.

Catalog 23, from Pass & Seymour, illustrates and describes Handy Electrical Wiring Devices manufactured by the company. These include sockets, rosettes, shade holders and receptacles of various types.

NEWS NOTES

INCORPORATIONS.

Elberton, Wash.—The Elberton Rural Telephone Company has been incorporated as a mutual company by W. H. Richard, H. F. Poffenroth and C. I. Daniel.

CHEWELAH, WASH.—The Chewelah Telephone Company has been incorporated with a capitalization of $10,000 by W. M. Anderson, Tekoa; F. J. Wilmer, Rosalia, and Albert I. Kulzer, Chewelah.

SEATTLE, WASH.—The Storage Battery Service has been incorporated with a capitalization of $10,000 by L. J. Ranney, George K. Taylor. Filed by W. W. Montgomery, Hoge building, Seattle.

SEQUIM, WASH.—The Sequim Light & Power Company has been incorporated with a capitalization of $3500 by Joseph L. Keeler, Sequim; Charles J. Farmer, Seattle, and Paul C. Farmer, Sequim. Filed by C. J. Farmer, 1110 White building, Seattle.

ILLUMINATION.

STOCKTON, CAL.—The people of Ripon and Manteca have voted in favor of creating highway lighting districts.

PULLMAN, WASH.—The ordinance granting to L. H. Burnett of Seattle a 50 year gas franchise has been passed by the council.

COULEE CITY, WASH.—The city council has agreed to grant a franchise to Oscar Ellefson to install an electric lighting system in this city.

WALLACE, IDAHO.—John H. Wourms plans installapany's bid of $1300 has been accepted for installing the new electroliers on Washington street.

LOS ANGELES, CAL.—The board of supervisors has accepted the bid of the Pacific Light & Power Corporation for furnishing current for the lighting system in the Angeles-Mesa Lighting District.

PASADENA, CAL.—C. C. Glass has been given further extension of ten days on his South Fair Oaks lighting contract because of delay in furnishing transformers by the General Electric Company.

LOS ANGELES, CAL.—The city council has adopted an ordinance for the ornamental lighting of Oxford avenue and Hobart Boulevard, between Third and Ninth streets, also for the lighting of Victoria Park.

BERKELEY, CAL.—Commissioner of Public Works Robson has submitted a plan to the council for the creation of special districts within the city on which an assesment will be levied to install electroliers.

AZUSA, CAL.—The city trustees have adopted a resolution ordering lighting posts constructed in Centre street from Cerritos avenue to Orange street and Azusa avenue from Tenth street to Fifth street.

RIVERSIDE, Cal.—The Riverside Chamber of Commerce in connection with similar bodies of San Bernardino, Redlands and Colton, is going to investigate the feasibity of obtaining natural gas in Riverside County and piping it to different localities.

ESCALON, CAL.—At a special election Escalon voted to tion of a chain of gas plants in northern Idaho as soon as preliminary arrangements are completed with the Idaho state utilities commission. Franchises have been secured or are pending in Wallace, Coeur d'Alene and Sandpoint.

BAKER CITY, ORE.—The report of Engineer Stockman shows that the enlarging of the penstock and increasing the size of the pipe line for a distance of 1200 ft. will give enough power to furnish adequate street lighting. Work on the penstock and pipe line will be under way within 15 days.

LOS ANGELES, CAL.—The Southern California Gas Company is seeking an order from the State Railroad Commission, setting aside the decision of Judge B. F. Bledsoe. The city of San Bernardino has asked the commission to fix a rate on electric light and power current.

ORANGE, CAL.—A plan calling for the installation of from 36 to 44 ornamental light posts in the business district of Orange is under consideration by the city trustees. One district proposed runs from Lemon street to Grand street on Chapman avenue and from Maple to Almond avenue on Glassell street.

BAKERSFIELD, CAL.—Eugene Schimpf, inspector for the California Natural Gas Company has concluded his inspection of the 48 miles of pipe line from the Buena Vista hills to the standard refinery in this city, which has just been completed. The line was constructed at a cost of $250,000, and the date set last spring for its completion was September 1. The Standard and Union oil companies in the Kern fields expect to take a large volume of gas for refining purposes, but it is also intended that the gas shall be used for other industries in this city.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation has applied to the Railroad Commission for a refixing of gas rates. The corporation alleges that the 68-cent rate, fixed by the city, does not yield a reasonable remuneration, and that the furnishing of a mixture of natural and artificial gas, approximating 1000 B.t.u. means a 20 per cent decrease in consumption. Among the allegations made by the corporation in its application is that it has been discouraged in its efforts to distribute the mixed gas by rates that have been actually confiscatory. The corporation also asks that the value of its plant for the making of artificial gas be included as a factor in determining rates, as it is absolutely necessary, it states, for the concern to protects itself against a possible break in the natural gas line.

TRANSMISSION.

WALLA WALLA, WASH.—The Pacific Power & Light Company has filed application with the county commissioners for a franchise for a power line rfom Waitsburg to Prescott.

MARTINEZ, CAL.—Application has been made to the Contra Costa Board of Supervisors by the Great Western Power Company to extend lines from Martinez to Crockett and from Concord to Walnut Creek.

THE DALLES, ORE.—Toward a $500,000 power and canal project on Snake River $400,000 will be raised in Lewiston, Idaho, if the government will furnish $100,000. This offer was made to the Congressional Rivers & Harbors Committee by Robert A. Foster, who was sent here by the Lewiston Chamber of Commerce. The dam and power plant will be constructed by local interests if they are allowed to sell power. The government will be asked to pay for building the locks through the dam.

TELEPHONE AND TELEGRAPH.

WALLA WALLA, WASH.—Forest Ranger W. H. Kendall was in the city recently conferring with forestry officials here regarding the extension of the government telephone lines into the Wenaha reserve, placing the entire forest of Eastern Oregon in connection with the settlement.

TRANSPORTATION.

SAN LEANDRO, CAL.—A petition is in circulation asking the Southern Pacific Company to extend its electric train service from the Oakland mole to San Leandro and Haywards.

LOS ANGELES, CAL.—At a meeting of the city council the city attorney was instructed to prepare a notice of sale of a franchise petitioned for by the Pacific Electric Railway Company, providing for two per cent on gross receipts.

SAN FRANCISCO, CAL.—The Mammoth Copper Company is building a road to the Friday-Lowden mine from the Mammoth smelter, which will facilitate shipments of ore and supplies. An electrically operated tramway two miles long is to be constructed.

HERMOSA BEACH, CAL.—The Hermosa Beach Chamber of Commerce has taken steps to obtain a five-mile right of way to build a railroad connecting with the Short Line of the Pacific Electric Company at Belvedere, leading into Los Angeles over the Gardena route.

PORTLAND, ORE.—The Oregon Electric Railway will expend a considerable sum this summer in building yards and warehouses. Stockyards and runways will be installed at Harrisburg and Corvallis. Warehouses will either be built or improved at Woodburn, Eugene, Harrisburg, Butteville, Hillsboro and Forest Grove and a sidetrack is to be installed at Junction City.

RICHMOND, CAL.—An electric line from Point San Quentin connecting with Marin county points is being considered by the Olsen & Mahoney interests as an addition to their present Richmond-San Rafael ferry system. The new line would furnish service to San Quentin prison and other places in Marin county, and form a connecting link with the cars of the S. F. O. T. Railways, operating through Richmond.

RICHMOND, CAL.—Announcement has been made by John H. Nicholl that the Nicholl estate will soon build an electric road from the present trolley system at Ashland avenue over Richmond avenue to a connection with the standard railroad spur now being constructed by the Nicholl estate from the Santa Fe line to the present brick works. This will provide railroad service around the entire southern horn of the Richmond peninsula.

WATERWORKS.

EVERETT, WASH.—An election on bonds to the amount of $7000 for a more complete water system did not carry.

ROSEBURG, ORE.—Petitions are in circulation here requesting the council to proceed to issue bonds and install a water and light system.

CENTRALIA, WASH.—The purchase of the system of the Toledo Water Company is being considered by the town council. The water company has set the price at $11,967.

ST. MARIES, IDAHO.—The council, by unanimous vote, has put all waterusers on a meter basis. The council has agreed to install a pumping plant east of St. Maries to supply water in case of emergency.

WINLOCK, WASH.—A deal has been consummated whereby C. E. Leonard purchased the water system belonging to Thomas H. Crocker. This includes the transfer of the springs, pipes and other appurtenances, together with the franchise.

WARRENTON, ORE.—The municipality of Warrenton has awarded the contract for supplying the wood pipe for its water system to the National Tank & Pipe Company. The system will cost about $150,000. Bonds for financing were sold to Percy, Briggs & Slaton, of Toledo, Ohio.

HALFWAY, ORE.—Local taxpayers have voted to issue bonds in the sum of $20,000 for the construction of a municipal waterworks. According to specifications prepared by H. G. Wright, hydraulic and civil engineer, Halfway will have 30,000 ft. of pipe line.

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